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HINTS TO TRAVELLERS

SCIENTIFIC AND GENERAL

TENTH EDITION

REVISED AND CORRECTED

FROM THE NINTH EDITION EDITED FOR THE

Council of the Royal Geographical Society

BY

E. A. REEVES, F.R.A.S., F.R.G.S.

*Map Curator and Instructor in Surveying to the Royal
Geographical Society.*

~~B 688~~

VOL. II.

METEOROLOGY, PHOTOGRAPHY, GEOLOGY, NATURAL
HISTORY, ANTHROPOLOGY, INDUSTRY AND
COMMERCE, ARCHÆOLOGY, MEDICAL, ETC.

LONDON

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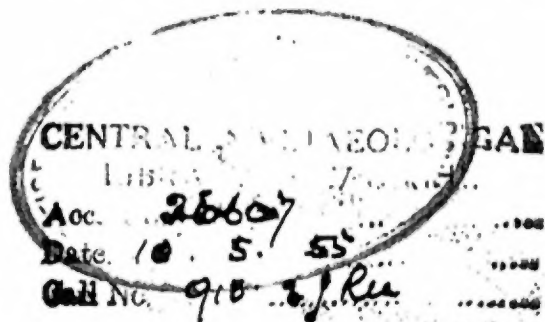
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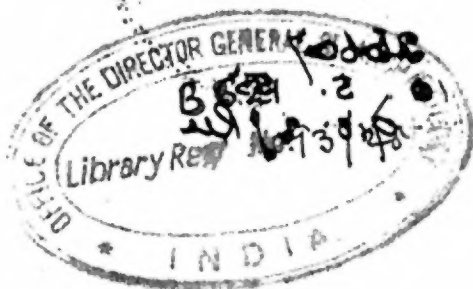


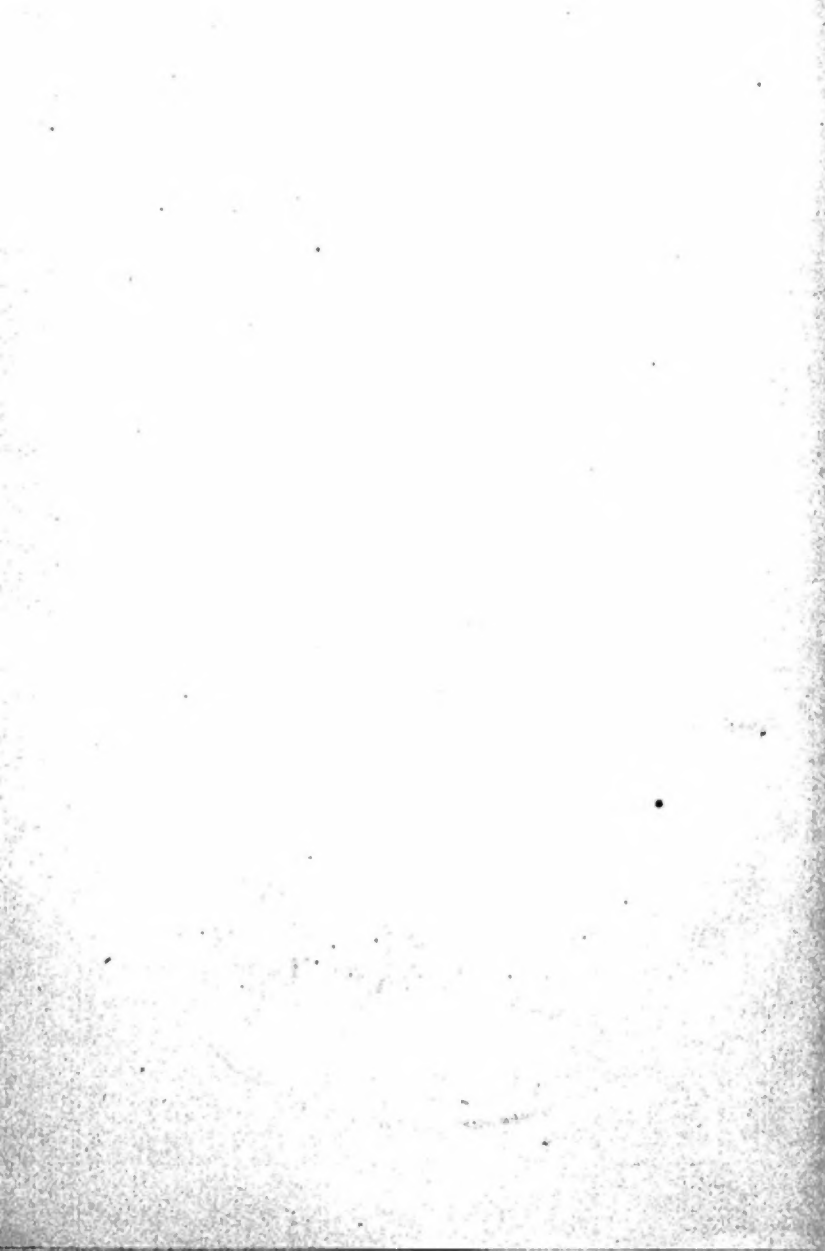
PREFACE TO VOLUME II.

THE first seven sections of this volume have been carefully revised, but required no serious alteration. The eighth section required very extensive changes and additions, due to the great progress of Tropical Medicine in the last fourteen years. The Society is much indebted to Dr. Andrew Balfour, C.B., C.M.G., Director-in-Chief of the Wellcome Bureau of Scientific Research, who has very kindly revised and extended the Medical Hints in the light of his wide experience in the Sudan and in the East during the War.

In the instructions for the use of drugs the word "tablet" has been used to denote products compressed in the form usually described by a proprietary word that belongs in law only to the products of a particular firm.

A. R. H.





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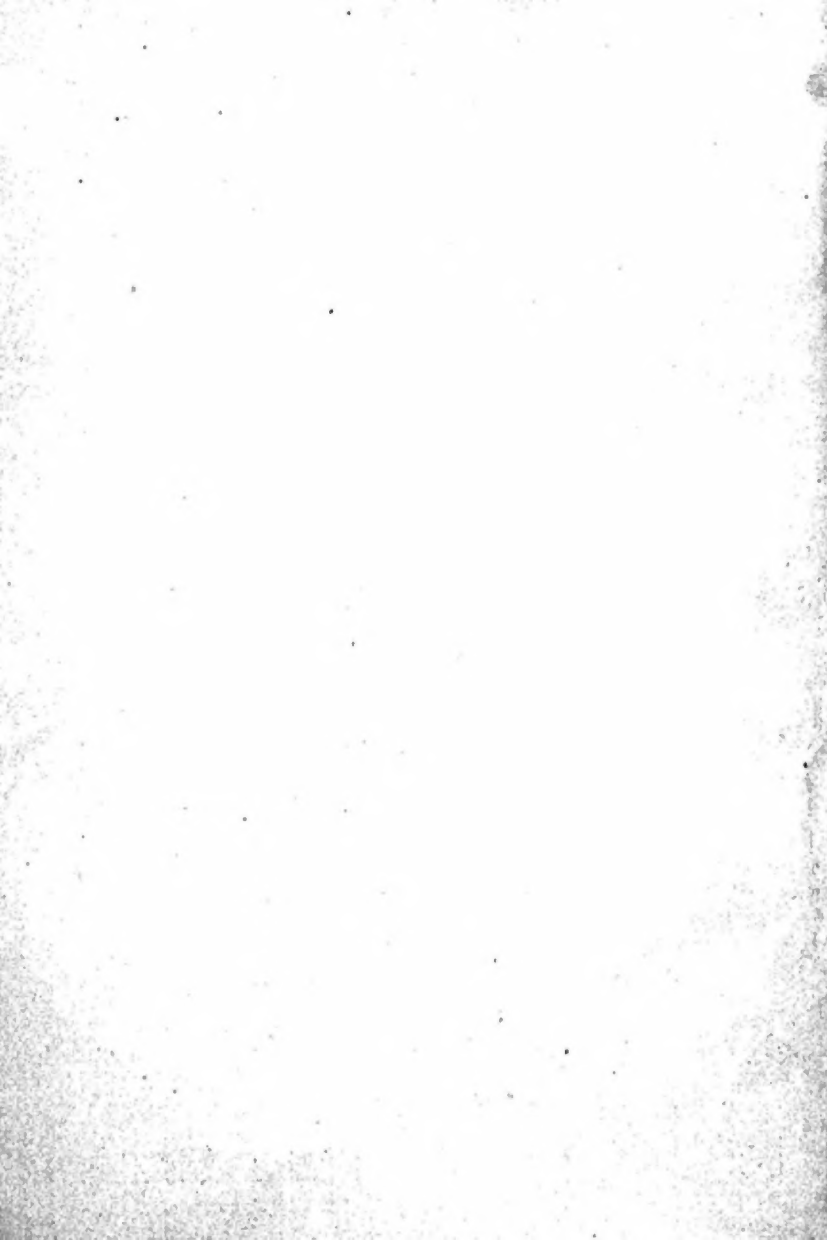
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HINTS TO TRAVELLERS.

VOL. II.

I.

METEOROLOGY AND CLIMATOLOGY.

By HUGH ROBERT MILL, D.S.C., LL.D., F.R.S.E.,
*Formerly President Royal Meteorological Society, and Director
of the British Rainfall Organization.*

THE nature of the meteorological observations made by a traveller or by a resident in regions where there is no organised meteorological service will necessarily depend on the object which he has in view, the time he is able to devote to meteorological work, his knowledge of meteorology as a science, and his interest in it.

Of the many ways in which a traveller may add to the knowledge of atmospheric conditions, five may be specially mentioned:—

1. *A record of the weather, observed day by day with regard both to non-instrumental observations and the readings of instruments.* This may be taken as the minimum incumbent on all travellers.
2. *Observations for forecasting the weather and obtaining warning of storms.* This is sometimes of vital importance; it is always valuable at the time, and occasionally the results are worth recording. It may, however be looked upon as a practical application of the systematic observations.

3. *Observations with a view to determining the character of the local climate.* The traveller passing through a country can do little in this way, as long continued uniform observations in one place are necessary to fix the annual variations. Still, the recording of such data as may be obtained is always important in a little-known region, and the work of several travellers at different seasons will allow some fair deductions to be drawn. When a day is spent in camp, much importance attaches to regular observations made every two hours, from which the diurnal changes of climate may be ascertained.
4. *Special meteorological researches.* These usually demand special instruments and skilled observers. Observations in the upper air by kites or balloons in particular, must be an end in themselves. Exact measures of radiation in deserts, of rainfall in forests and on adjacent open ground, of temperature during land and sea breezes, or of fogs, thunderstorms, tornadoes, etc., in places subject to those visitations, are always of value. As a rule, however, the traveller cannot devote much time to these matters, unless the study of physical geography is the object of his journey.
5. *The collection of existing meteorological records.* It sometimes happens that at outlying stations meteorological observations have been taken and recorded for a considerable time. If they have not been already communicated to some meteorological centre, the traveller should obtain a copy of them, and also compare the instruments in use with his own. He might in some cases aid in securing a knowledge of local climate by inducing residents at outlying stations to start regular observations.

The first two ways of advancing meteorology need alone be considered in detail; but with regard to all, it must be clearly understood that the value of the work is greater the more carefully the observations are made and recorded, and the more remote and less known the region.

1. **A RECORD OF WEATHER.**—The traveller who makes his journey for any other purpose than the study of physical geography would be wise to burden himself as little as possible with instruments, but to understand thoroughly and use faithfully the few he carries. In a rapid march many different climates may be traversed in a few weeks, and the

records of variation of weather so obtained could not have much value; but when a halt of a few days or of a week or two is made, systematic observations become valuable.

NON-INSTRUMENTAL OBSERVATIONS.

The first place must be given to non-instrumental observations, which may be made at any time on the march or in camp, and should always be noted at the time they are made in the rough note-book, and copied carefully into the journal each evening. These observations in the rough note-book will necessarily be mixed up with others on various subjects; but the meteorological facts should have a place reserved for themselves in the journal, say at the end of each day's work.

Wind.—Observations of the direction and force of the wind at several fixed hours in the day are advisable for comparison with instrumental readings; but on the march every decided change should be recorded if the nature of the country permits. In the depths of a forest, or in a narrow valley, the wind, if felt at all by the traveller, gives scarcely any clue to the movement of the air over the open country, but in most cases the movements of low clouds, when any are in sight, may be taken as a fairly satisfactory test. The direction is to be observed by means of the compass, and it will be sufficient to estimate it by the eight principal points—North, North-east, East, South-east, South, South-west, West, and North-west. Any sudden changes in direction so pronounced as to be noticeable should be recorded, for, taken in conjunction with the barometer readings, if the journey is along a route of nearly constant level, they are valuable aids in predicting the weather. In some places the direction of the wind undergoes a well-marked regular diurnal change in perfectly settled weather.

Wind is always named by the direction from which it blows. The force of the wind is best estimated on the scale Calm, Light, Moderate, Fresh, Strong, and Gale. It is impossible, without long experience and the tuition of a trained observer, to assign relative numbers to these forces which should have any permanent value for comparison with the observations of others. Travelling on foot in a strong wind is always uncomfortable, and in a gale very difficult. If it is impossible to make way against the wind at all, or to pitch tents, the force may be put down

as Hurricane after it has passed, the traveller bearing in mind that if he can write in his note-book at all, while unsheltered, a hurricane is not blowing. If a lake or a river without appreciable current is in sight, wind just sufficient to produce white crests on the waves may be called fresh, and that sufficient to blow away spray from the crests deserves to be termed strong. At sea, in a sailing-vessel, it is possible to acquire great skill in estimating wind-force; hence Beaufort's scale, originally devised with reference to the amount of sail a well-equipped frigate could carry, has come into extensive use, and it is as well to know it. By comparison with anemometers, the approximate velocity in miles per hour corresponding to the numbers on the scale has been estimated:—

BEAUFORT'S SCALE OF WIND FORCE.*

| No. | Name. | Mean Velocity in miles per hour. |
|-----|---------------------------|----------------------------------|
| 0 | Calm | 0 |
| 1 | Light air | 1 |
| 2 | Light breeze | 4 |
| 3 | Gentle breeze | 9 |
| 4 | Moderate breeze | 14 |
| 5 | Fresh breeze | 20 |
| 6 | Strong breeze | 26 |
| 7 | Moderate gale | 33 |
| 8 | Fresh gale | 43 |
| 9 | Strong gale | 51 |
| 10 | Whole gale | 62 |
| 11 | Storm | 75 |
| 12 | Hurricane | 92 |

The duration of strong wind should be noted, as well as the time of any marked change of strength. The land and sea winds of tropical coasts show a well-marked relation to the position of the sun and the hour of sunset, and in places where these winds blow the hours of calm and change should be noted. On mountain slopes a similar diurnal effect may be noticed; the wind usually blows uphill during the day and down-

* Equivalents obtained by Mr. R. H. Curtis using Köppen's method. See 'Symons's Meteorological Magazine,' 40 (1905), p. 157.

hill at night, while in valleys it usually blows either with or against the direction of the river. Local winds of peculiar character are sometimes met with in association with mountains such as the Föhn of the Alps, the Chinook wind of the Rocky Mountains, and the Helm wind of the Eden Valley in England and Adam's Peak in Ceylon.

Whirlwinds and tornadoes are rare phenomena, but if met with, it is worth while to take some trouble to put on record at least the hour of their appearance (local time), the direction in which the whirl moves onward, and the breadth of the path of destruction it leaves behind. When a storm of wind has passed over a wooded region and blown down many trees, the direction in which most of the trunks lie is worth observing. The top of the tree usually falls in the direction in which the wind was blowing, hence the root usually points to the direction of the wind. Waterspouts are closely allied to whirlwinds, and in any of those phenomena of revolving columns of air it is of much theoretical importance to determine the direction of the whirl about the axis, *i.e.*, whether the rotation is in the direction of the hands of a watch or the opposite. The prevailing wind of a district may often be discovered by the slope of trees growing on open ground, or still better, by the difference in the degree of wave erosion on small lakes. If the banks are of the same material all round, the side against which the prevailing wind drives the waves will always be the most worn away.

Cloud and Sunshine.—It would be impossible to keep a record of the countless changes in the cloud-covering of an English sky, but in many parts of the world the absence or presence of cloud is a function of latitude, altitude, and season, of great stability, and worthy of being attentively studied. The amount of cloud is usually estimated as the number of tenths of the sky covered; but it is a very difficult thing indeed to compare a tenth of the visible sky near the horizon with a tenth near the zenith. There is no difficulty, however, in observing when the sky is completely overcast or quite free of cloud, and as a matter of convenience the belt round the horizon to the height of thirty degrees may be neglected, *i.e.*, the lower third of the distance from the horizon to the zenith. Very often it will be found that clouds form and disappear at certain hours of the morning or evening, and it is useful to get exact information on the subject.

Of more importance than the amount of cloud is its nature, elevation, and movement. Distinct species of cloud have been recognised for a

long time, and from more recent studies it would appear that they owe their distinctive appearance to the altitude at which they float in the air. Meteorologists distinguish a number of classes and transitional forms of cloud; it is enough for the traveller to be able to recognise the most definite types, viz., Cirrus, Cumulus, Stratus, and Nimbus. *Cirrus* clouds are the small tufts or wisps of cloud which float very high in the atmosphere, and to which the popular name of "mare's tails" is applied. The transitional form, *Cirro-Cumulus*, popularly known as "mackerel scales" or "mackerel sky," is equally easy to identify. *Cumulus* clouds are great woolly-looking heaps of cloud, the lower surface of which is often nearly horizontal, while above they well into an exuberant variety of rounded forms. They represent the condensation of moisture in ascending columns of heated air. *Stratus* clouds are low-lying sheets of condensed moisture, which, being usually seen at a low angle, appear like thin layers parallel to the horizon. The transitional type *Cirro-Stratus* is usually seen in the form of great feather-like clouds stretching across nearly the whole sky. *Nimbus* is a rather low-lying cloud from which rain is falling even if the rain is re-evaporated before reaching the ground. The lowest clouds of all, those resting on the surface of the ground and enveloping the observer, are called *mist* and *fog*. The two are distinguished by the fact that a mist wets objects immersed in it, while a fog does not. All clouds, except Cirrus, are physically the same, consisting of minute globules of liquid water falling through a portion of air saturated with moisture. The globules being small offer a relatively great surface to friction, and so fall very slowly, and in the higher clouds they evaporate on the lower surface before they have time to agglomerate into raindrops. In the highest of all clouds, the cirrus type, the particles are spicules of ice and not globules of water. It is a common error to suppose that black clouds differ from white clouds. All clouds are white when they reflect the light of the sun, and all are black when they come between the eye and the sun in sufficient thickness to cut off a considerable portion of its light.

The sudden appearance of a particular kind of cloud is important as a weather sign. It shows that changes are going on in the vertical circulation of the atmosphere. Hence if cirrus or cumulus cloud should be observed to be increasing the fact should be noted, and the direction in which the clouds are moving should be noted also.

In observing cloud-motion attention should be given only to the sky overhead; at any lower angle the parallax due to viewing the clouds obliquely deprives the observation of value. It is also necessary to distinguish between the movement of the upper and of the lower clouds, as these are floating in very different parts of the atmosphere. It is comparatively rarely that the motion, say of nimbus and cirrus, is in the same direction. On a lofty mountain, strata of cloud which from below were seen to be cumulus may be passed through as layers of mist, and on emerging from them their upper surface may be seen below one. In many mountains the cloud-belt is as sharply defined as the snow-line, and its variations should be carefully observed.

Clouds should occasionally be photographed as a record. This should be done especially when a type of cloud comes to be recognised as a usual one, for while exceptional forms may prove interesting, a record of the usual forms is certain to be valuable. In this connection a protest may be made against the horrible custom of some amateur and of many professional photographers of printing in clouds from some stock negative in their pictures of scenery. The cloud is an essential part of a picture, and it is better to leave an over-exposed sky of natural cloud than to insert a beautiful representation of a cloud-form which may be one never visible in the particular place or at the particular season.

Mist, Fog and Haze.—Mist or fog at low levels will of course be recorded whenever observed, and its density and duration noted. A good way to define the density of thick fog is to measure the number of yards at which an object becomes indistinguishable, and the most convenient object for the purpose is a person. Light mists lie over water or marshes at certain hours in particular seasons, and their behaviour should always be observed. It often happens that the distant view from a height is obscured by a haze not due to moisture, and this appearance should be noticed with a view to discovering its cause. The smoke from forest or prairie fires in Canada sometimes produces so thick a haze as to put a stop to surveying operations for weeks at a time. Haze is often due to dust blown from deserts, or ejected from volcanoes, and sometimes to swarms of insects.

Rain and Dew.—The journals of most travellers fail to give a clear idea of the prevalence of rain during their journeys, and it is much to be desired that something more explicit than "a showery day" or

"fairly dry" should be recorded. The hour of commencement and cessation of rain during a march should be noted, and some indication given as to whether the rain fell heavily or lightly. In this way any tendency to a diurnal periodicity of rain would be detected, and some definite meaning would be given to the terms rainy season and dry season. If rain occurs during the night it should also be recorded, and the amount of night rains should always be measured by means of a rain gauge in the manner to be described later.

The general condition of a country with regard to rain may often be judged from the appearance of vegetation or the marks of former levels of high-water in lakes or rivers. Thus on mountain slopes or the sides of a valley any difference in the luxuriance of vegetation according to exposure probably indicates the influence of rainfall as guided by the prevailing wind. So, too, the appearance of lines of drifted débris on the banks some distance from the edge of a lake or river may be taken as indications of the height to which the waters sometimes rise; and conversely the appearance of rows of trees in the middle of a wide shallow lake may indicate the line of a river which has temporarily flooded the surrounding meadows. Such observations have an important bearing on climate.

The appearance and amount of dew are also to be recorded. The most important points to notice are the hour in the evening when the deposit commences, and the hour in the morning when the dew disappears. It should be noted also whether the deposit of dew is in the form of small globules standing apart on exposed surfaces, or if it is heavy enough to run together into drops and drip from vegetation to the ground.

Thunderstorms and Hail.—The occurrence of thunderstorms should of course be noted, and here the hour of occurrence is of very great importance, for thunderstorms frequently show a marked diurnal period. The appearance of lightning without thunder should be recorded when it is observed, but this will naturally be almost always after sunset. Hailstorms usually accompany thunderstorms, and sometimes take the place of them. The occurrence of hail is most frequent in summer, and records of the size of hailstones are important. If possible they should, when very large, be photographed along with some object of known size, and their structure described. It might at least be noticed whether they are hard and clear, like pure ice, or opaque like compacted snow, or made up of concentric layers of clear and opaque ice alternately.

Snow.—Snow falls in all parts of the world, although in tropical or subtropical latitudes only at great elevations above sea-level. The actual limits of snowfall at sea-level are as yet imperfectly known, and any observations of snow showers in the neighbourhood of the tropics are of importance. It is essential in such a case to record also the approximate elevation of the land. On mountains in all latitudes the position of the snow-line should be noted at every opportunity. This is the line above which snow lies permanently all the year round, or below which snow completely melts in summer; and it is a climatic factor of some importance. It may be remarked, for instance, that if the traveller finds snow lying on grass, moss, or other vegetation, he is certainly not above the snow-line. It is necessary also to notice that glaciers may descend unmelted a long distance below the level of perpetual snow. While the conditions of snow lying on the ground in the Arctic regions and above the snow-line in any part of the world are matters pertaining more to geology and mountaineering than to meteorology, the duration of snow-showers, the character of the snow, and the depth to which it lies on ground below the snow-line are too important from their bearing on climatology to be overlooked.

The character of the snow as it falls varies from the sleety, half-melted drops common in warm air to the fine dust of hard, separate ice-crystals found in the intense cold of a Polar or Continental winter. The feathery appearance of lightly-felted flakes is an intermediate type between the two extremes. In measuring the depth of snow as it lies, care should be taken to select open ground where there is no drifting, and when the snow is not too deep the measurement can usually be best made with a walking-stick on which a scale of feet and inches (or of centimetres) has been cut. Such a stick is useful for measuring the depth of shallow streams, and for many other purposes. The result should be entered as "depth of fallen snow," so that there may be no risk of confusing the figures with the amount of snowfall estimated as rain. Speaking roughly, a foot of snow is usually held to represent an inch of rain. A violent storm of wind, accompanied with falling or driving snow, is termed a *blizzard* in the western United States, and a *buran* in Siberia. The name blizzard has been naturalized in the Antarctic, but it is not known that this phenomenon is identical with the American storm.

Frost.—The appearance of frost in the form of hoar-frost (the way in

which atmospheric water-vapour is deposited in air below the freezing-point), or of thin ice formed on exposed water, should always be carefully looked for and noted. In hot, dry countries the intense radiation from the ground at night often reduces the temperature below the freezing-point, although, during the day, the ground may be very hot. The appearance of frost at sunrise is a valuable check on the readings of a minimum thermometer, and in most cases is a more trustworthy datum. Similarly in cold countries, where snow is lying on the ground or ice covering the rivers, the appearance of thaw, especially in cloudy weather, is a delicate test of the rise of the air temperature to the freezing-point. The traveller should never fail to record cases of melting and solidifying of any substances due to changes of temperature. The softening of candles and the freezing of mercury or of spirits give information regarding temperature at least as valuable as the readings of thermometers.

Other Observations.—Any peculiar atmospheric phenomena, such as the appearance of the zodiacal light after sunset, the aurora, the electrical lights seen on pointed objects, and known as St. Elmo's fire, rainbows, especially lunar rainbows, haloes, the appearance of mock-suns or moons, meteors or shooting stars, should be noted on their occurrence, as many of them are valuable weather prognostics. Attention should also be given to any appearances of mirage, or other effects of irregular distribution of atmospheric density. A mirage is only rarely so perfect as to show ships inverted in the air, palm-grown islands in the sea, or distant oases in the desert. The common form is an unusual intensification of refraction, raising land below the horizon into sight, or apparently cutting off the edges of headlands or islands at sea or on large lakes. It is worth while observing the temperature of the air and of the water or ground when an unusually clear mirage effect is visible.

Another interesting series of observations may be made on the colours of the sky and clouds at sunrise and sunset. A phenomenon often observed at sunset, but the existence of which is still sometimes denied, should be looked for. This is the appearance of a gleam of coloured light at the moment when the upper edge of the sun dips below a cloudless horizon. A note should be made of the nature of the horizon, whether land or sea, and of the colour of the light if it should be observed. When opportunity offers, the first ray of the rising sun might be similarly observed.

The traveller should, at the end of each day, give his opinion of the nature of the weather, saying whether he felt it hot or cold, relaxing or bracing, close or fresh. Such observations have no necessary relation to degree of temperature or humidity as recorded by instruments; but the human body is the most important of all instruments, and everything which affects it should be studied. By paying attention to the foregoing instructions, an observant traveller will bring home a far better meteorological log without instruments than a more careless person could produce by the diligent reading of many scales. Yet, in enforcing the importance of non-instrumental observations, we must not leave the impression that the readings of instruments are of little value. It is, in ordinary circumstances, only by the readings of instruments that the climate of one place can be compared with that of another, and only the best results of instrumental work are precise enough to form a basis for climatological maps.

INSTRUMENTAL OBSERVATIONS.

The minimum requirement of instrumental observations by a traveller is the reading twice daily of the barometer and of the dry and wet bulb thermometers, to ascertain the temperature and humidity of the air, also the reading once daily, in the morning, of the minimum thermometer which has been exposed all night, and on days in camp of the maximum thermometer also. It is very desirable to expose a rain gauge whenever it is practicable to do so. Unless special meteorological researches are to be carried out, nothing farther in the way of observations need be attempted. A very useful supplement to the necessary observations is the use of a self-recording barograph or thermograph; but these are delicate instruments, liable to get out of order unless very carefully handled, and it will not always be possible to make use of them.

The observer must understand what his instruments are intended to measure, how they act, and how they should be exposed, read, and the reading recorded. He must know enough about all these things to be able to dispense with unnecessary precautions only possible at fixed observatories, and, at the same time, to neglect nothing that is necessary to secure accuracy in the results.

Thermometer Corrections.—All thermometers, without exception, should have the degree marks engraved on the stem, or on a slip of enamel within the outer tube, and be supplied with a certificate from the National Physical Laboratory showing the error of the scale at different points. This certificate should be in duplicate, and a copy ought to be left in a safe place at home. After a long journey the thermometers which have been in use should be sent to have their errors re-determined. The corrections are not, however, to be applied by the observer unless he is working out his observations for some special purpose. No thermometer is passed at the National Physical Laboratory if its error approaches one degree, so that for all ordinary purposes of description a certificated thermometer may be looked on as correct. But when the readings are being critically discussed and compared with the observations of other people, the correction is of the greatest importance. *It cannot be too strongly impressed upon an observer that, in reading meteorological instruments, he must read exactly what they mark, and record that figure in his observation-book on the spot.* The corrections can be applied afterwards by the specialist who discusses the work. For subsequent reference it is necessary to note in the observation-book the registered N.P.L. number of the thermometer in use, and if a thermometer should get broken and another be used instead, the number of the new instrument must be noted at the date where it is first employed. Care should be taken to use the same thermometer for one purpose all the time if possible, and only an accident to the instrument should necessitate a change being made.

Thermometers are either direct-reading or self-registering. The former are used for obtaining the temperature at any given moment, the latter for ascertaining the highest or the lowest temperature in a certain interval of time. They are filled either with mercury, or a light fluid which freezes less readily, such as alcohol or creosote.

Thermometer Scales.—The particular system on which the thermometers are graduated is of no importance, but merely a matter of convenience. The Fahrenheit scale is used for meteorological purposes in English-speaking countries; but for all other scientific purposes the Centigrade scale is used everywhere. One can be translated into the other very

simply by calculation*; but it is convenient for a traveller to have all his thermometers graduated in accordance with one scale only.

The graduation, as marked on the stem of the thermometer, is usually to single degrees, but anyone can learn to read to tenths of a degree by a little practice. Care must be taken to have the eye opposite the top of the mercury column. Suppose it to be between 50 and 51, the exact number of tenths above 50 is to be estimated thus: If the mercury is just visible above the degree mark it is $50^{\circ}\cdot 1$, if distinctly above the mark $50^{\circ}\cdot 2$, if nearly one-third of the way to the next mark $50^{\circ}\cdot 3$, if almost half-way $50^{\circ}\cdot 4$, exactly half-way $50^{\circ}\cdot 5$, a little more than half-way $50^{\circ}\cdot 6$, about two-thirds of the way $50^{\circ}\cdot 7$, if nearly up to the next mark $50^{\circ}\cdot 8$, and if just lower than the mark of 51° it is $50^{\circ}\cdot 9$. The eye soon becomes accustomed to estimating these distances.

In using a thermometer below zero, the observer must pay attention to the change in the direction of reading the scale, the fractions of a degree counting downward from the degree mark instead of upward from it, as in readings above zero. Readings below the zero of the scale are distinguished in recording them by prefixing the minus sign. The annexed figure shows the reading of two thermometers graduated to fifths of a degree, one showing a temperature of $1^{\circ}\cdot 4$, the other of $-1^{\circ}\cdot 4$. The British Meteorological Office now recommends the use of the Centigrade thermometer graduated from the absolute zero, i.e., the freezing point is shown by 273° , the boiling point as 873° .

Care of Thermometers.—Mercurial thermometers will always be employed for ordinary purposes in places where the temperature is not likely to fall to -40° : i.e., everywhere except in

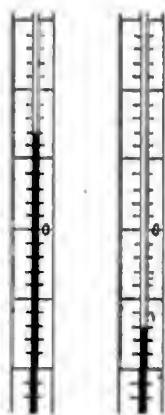


FIG. 1.—Reading Thermometer Scale above and below Zero.

* For comparison of scales see Table XXVI., Vol. I., p. 383.

To convert Centigrade readings into Fahrenheit the rule is "Multiply by 1.8 and add 32." This can be done mentally in a moment, thus: "Multiply by 2, subtract one-tenth of the product, and add 32." *E.g.*, to convert 10° C. to F.: $10 \times 2 = 20$; one-tenth of $20 = 2$; $20 - 2 = 18$; $18 + 32 = 50^{\circ}$ F.

the polar regions and the interior of continents north of 50° N. These thermometers are very strong and are not easily broken except by violence. The one vulnerable part is the bulb, which is of thin glass and filled with heavy mercury. Hence, in carrying thermometers, care has to be taken to protect the bulb from coming in contact with any hard object. The best way to carry an unmounted thermometer is in a closed brass or vulcanite tube with a screw top, the inside of the tube being lined with india-rubber and provided with a cushion of cotton-wool for the bulb to rest on. If the thermometer is mounted in a wooden frame it should be secured in a box so that the frame is firmly held and the bulb projects into a vacant part of the box, which may be lightly filled with cotton-wool or provided with a deep and well-padded recess. Every thermometer which is not graduated above 120° should have an expansion at the top of the tube which the mercury that may be driven beyond the scale by over-heating will not fill; otherwise any accidental over-heating will break the bulb.

The unavoidable shaking or any sudden shock during travelling is apt to cause the mercury column to separate, and a portion of it may be driven to the top of the tube, where it may remain unless looked for and brought back. Hence it is important to see that the top of the bore of the tube is visible, and not covered by any attachment holding the tube to a wooden frame. Thermometer readings are absolutely valueless unless the whole of the mercury fills the bulb and forms a continuous column in the stem. To bring a broken column together the best plan is to invert the thermometer, if necessary shaking it gently, until the mercury flows from the bulb and entirely fills the tube, leaving a little vacant dimple in the mass of mercury in the bulb. When this is done, the thermometer should be brought into its normal position bulb downwards, and the column will usually be found to have united. If this method does not succeed the thermometer may be held in the hand by the upper end, raised to the full stretch of the arm, and swung downwards through a wide arc with a steady sweep. I have never known this method to fail.

Thermometer Screens.—It is usual at fixed stations to expose the thermometer to the air by hanging it in a screen made of louver-boards so arranged that the air penetrates it freely while the direct rays of the sun are out off. The Stevenson screen, constructed on this plan with a

door opening on the side away from the sun, is well adapted for use in temperate countries; but it is too cumbersome to carry on a journey and does not afford sufficient ventilation for use in tropical countries. An excellent substitute is the canvas screen devised by the late Mr. H. F. Blanford, which consists of a bamboo frame carrying the thermometers (with their bulbs four feet from the ground). The whole structure is five feet high, and is sufficient for any places where the wind is moderate. It is constructed of bamboos or rods of light wood, cords, and canvas, which may readily be made up before starting, and it is easily renewed



FIG. 2.—Mr. H. F. Blanford's Portable Thermometer Screen.

or repaired. The canvas roof should be triple or quadruple according to the thickness of the material. Such a screen will afford sufficient protection at night, or even in the day, if set up in the shade, and it will throw off rain; but in the sun it will require a thick mat as an additional protection on or preferably stretched above the roof.

For a more permanent station the form of exposure recommended by a committee of the British Association for use in tropical Africa will be found very suitable in hot countries.

The thermometers are placed in a galvanised iron cage, which is kept locked for safety. This cage is suspended under a thatched shelter,

which should be situated in an open spot at some distance from buildings. It must be well ventilated, and protect the instruments from being exposed to sunshine or rain, or to radiation from the ground. A simple hut, made of materials available on the spot, would answer this purpose. Such a hut is shown in the drawing (Fig. 2). A gabled roof with broad eaves, the ridge of which runs from north to south, is fixed

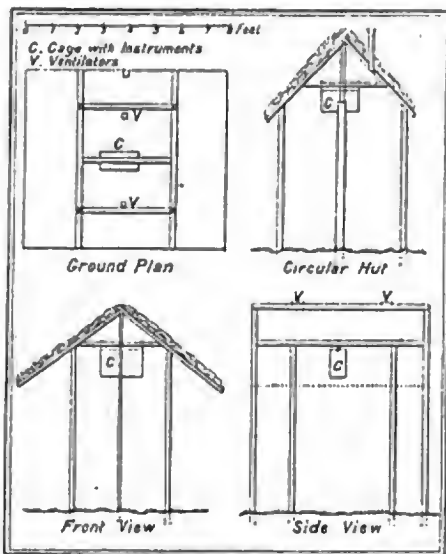


FIG. 3.—Hut for Sheltering Thermometers.

upon four posts, standing four feet apart. Two additional posts may be introduced to support the ends of the ridge beam. The roof at each end projects about eighteen inches; in it are two ventilating holes. The tops of the posts are connected by bars or rails, and on a cross bar is suspended the cage with the instruments. These will then be at a height of six feet above the ground. The gable-ends may be permanently covered in with mats or louver-work, not interfering with the free circu-

lation of the air, or the hut may be circular. The roof may be covered with palm-fronds, grass, or any other material locally used by the natives for building. The floor should not be bare but covered with grass or low shrubs.

The great object of these precautions is to obtain the true temperature of the air, and avoid the excessive heating due to the direct rays or reflected heat of the sun falling on the thermometers, and the excessive cooling due to the radiation of heat from the thermometers to a clear sky at night. Such a shelter is absolutely necessary when maximum and minimum thermometers are used; but can be dispensed with for the simple observation of the temperature of the air at a given time. This may be effected by securing a rapid flow of air over the thermometer, either by causing the air to flow past the instrument or by causing the instrument to move rapidly through the air. It has been found by experiment that the true temperature of the air is obtainable in this way whether the operation is performed in sunshine or in shade; but it is preferable to do so in the shade.

Sling Thermometer.—The sling thermometer is the most simple and convenient of all instruments for ascertaining the temperature of the air. It is an unmounted thermometer with a cylindrical bulb, and the degree-marks engraved on the glass stem. The upper end terminates in a ring to which a silk cord about two feet long is attached. As a precaution it is as well to secure the cord by a couple of clove hitches round the top of the thermometer stem as well as to the ring, as the thermometer would then be held securely even if the ring broke. The thermometer is used by whirling it in a vertical circle about a dozen times, the observer taking care, by having a loop of the string round the wrist or finger, that it is not allowed to fly off. Then the thermometer is read, swung once more, and read again. This process is repeated until two consecutive readings are identical; when this is the case the instrument shows the true temperature of the air. It is sufficient to note the final temperature in the observing book.

The risk of breaking a sling thermometer is the only drawback to its use. Only a silk cord should be used, and it should be examined frequently to see that it has not got chafed. In swinging the thermometer, an open place must be selected where it is not likely to come in contact with a branch or any other object.

Hygrometers.—As the humidity or degree of moisture in the atmosphere is a very important climatic factor it is necessary to measure it as carefully and as frequently as the temperature of the air. There are many instruments, called psychrometers or hygrometers, for doing this; but few of them are simple enough for the use of a traveller. The proportion of water-vapour in air is a little difficult to understand at first, because it is not a constant quantity as in the case of the other constituents of air, but varies according to the amount of water-surface exposed to the air and according to the temperature. The maximum amount of water-vapour which can be present in air varies with the temperature, being greater as the temperature is higher and less as the temperature is lower. Thus, if air at 50° F. contains the maximum amount of water-vapour which it can contain at that temperature, it is said to be *saturated*, for it will take up no more and evaporation stops; and if the temperature were to fall ever so little there would be more water-vapour present in the air than it could hold and some would separate out and condense into dew or rain, hence the temperature of saturation is called the dew-point. But if air saturated at 50° is warmed up say to 60° it can then contain more water-vapour than it has, and the temperature would require to fall 10° before dew or rain could form. When the air is not saturated water exposed to it evaporates rapidly until the maximum quantity of water-vapour is again present, a larger quantity corresponding to the higher temperature. At any given temperature the essential thing to know about the humidity of the air is the additional amount of water-vapour it could take up before becoming saturated, or in other words, the humidity relative to the maximum humidity possible at the existing temperature. The relative humidity is expressed in percentages of the maximum humidity possible (saturation) at the actual temperature of observation. It may be measured by two methods, (1) finding the dew-point or temperature at which the amount of vapour present saturates the air; (2) by finding the rate at which the air allows evaporation to proceed; the farther the air is from saturation the more rapid is the rate.

The dew-point may be found directly by means of an instrument by which the air is cooled down until it begins to deposit moisture on a polished surface, but such an instrument is inconvenient to handle when travelling. It may also be found indirectly by calculation from the relative humidity.

The relative humidity is most easily calculated from the rate of evaporation. It is one of the laws of evaporation that heat is required to change liquid into vapour, and when evaporation is going on heat is being abstracted from surrounding bodies, and they are growing colder. By allowing evaporation to take place from the bulb of a thermometer the rate of evaporation may be measured by the fall of temperature produced, and tables have been constructed to convert the differences between the wet and dry bulb readings into relative humidities.

The wet-bulb thermometer consists of an ordinary thermometer, the bulb of which is covered with clean muslin and kept moist by means of a piece of cotton lamp-wick dipping into a small vessel of pure water. Care must be taken to have the water quite pure and free from salt, otherwise the true reduction of temperature will not be observed. Hence special precautions are necessary when observing at sea or in an arid country where the ground is covered with incrustations of salt.

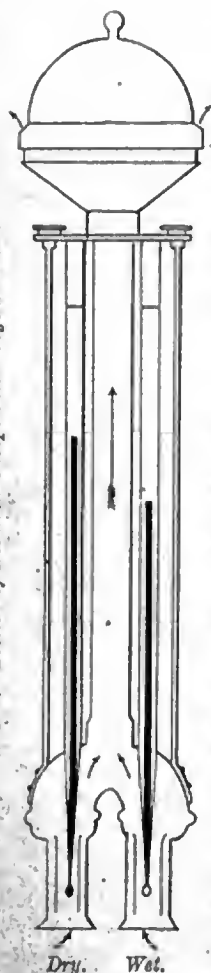
In any form of wet bulb thermometer when the air is much below the freezing point, it will usually be found most satisfactory to remove the muslin covering and allow the bulb to become covered with a coating of ice, by dipping it into water and allowing the water to freeze upon it. Evaporation takes place from solid ice sufficiently rapidly to give the true wet-bulb readings at least with a sling thermometer.

When the air is saturated, i.e., relative humidity=100 per cent., there is no difference in the reading of the wet and dry bulb thermometers, and the greater the difference between the readings at a given air temperature the smaller is the relative humidity of the air.

The wet-bulb thermometer has to be exposed to the air with the same precautions as are taken in the case of the dry bulb. The two may be hung side by side—but at least six inches apart—in the screen or cage described on p. 15; or the wet bulb may be employed as a sling thermometer. One way to do this is to tie a muslin cap on the bulb of the sling thermometer with a piece of wet lamp-wick coiled round the upper part of the bulb, and then whirl it until the reading becomes constant, taking care to moisten the bulb again if it should become dry. Another way is simply to twist a piece of filter-paper or blotting-paper round the bulb, and dip it in water before swinging.

Aspiration Psychrometer.—Perhaps the most convenient form of wet and dry bulb thermometer for use by a traveller is that known as

FIG. 4.—Section of Assmann's Aspiration Psychrometer.



Assmann's Aspiration Psychrometer. It requires no protecting screen, is not subject to the risk attending the use of the sling thermometer, and gives an extremely close approximation to the true temperature and humidity. The principle of the instrument is very simple. The wet and dry bulb thermometers are enclosed separately each in an open tube (see Fig. 4) through which a current of air is drawn by means of a fan, actuated by clockwork in the upper part of the case. In making an observation, all that is required is to see that the water vessel for the wet bulb is filled and the bulb properly moist, and that the dry bulb is free from any condensed moisture. The instrument is then hung to a branch or other support placed in the open air (or even held in the hand), preferably in the shade, although this is not essential, and the clockwork wound up. Air will then be drawn over the bulbs for five minutes or more, and if the temperature of each thermometer has not become steady by the time the clockwork has run down, it must be wound up again.

The thermometers in Assmann's Psychrometer are graduated according to the Centigrade scale, and each degree is subdivided into fifths on a slip of porcelain enclosed in the outer tube of the thermometer (see p. 18).

Minimum Thermometer.—The minimum temperature of the night can usually be ascertained by a traveller exposing a minimum thermometer when the camp is set up and reading it in the morning before starting on his way. There are several forms of minimum thermometer, but the only one likely to be used is that known as Rutherford's. It is very delicate and liable

to go out of order. The instrument should be of full size, as used in meteorological stations at home; it must be packed so as to be as free as possible from shock or vibration, and ought to be carried in a horizontal position. The bulb is filled with alcohol or some similar clear fluid, and within the column of spirit in the stem there is included a little piece of dark glass shaped like a double-headed pin. This is the index which continues pointing to the lowest temperature until the instrument is disturbed or re-set. The thermometer has to be hung in a horizontal position. When the temperature rises, the column of spirit moves along the tube, flowing past the index without disturbing it. When the temperature falls, the spirit returns towards the bulb, flowing past the index *until the end of the column touches the end of the index*. The phenomenon known as surface-tension gives to the free surface of any liquid the properties of a tough film, and the smaller the area of a free surface is, the greater is this effect of surface-tension. Hence it is that the inner surface of the column of alcohol is not penetrated by the glass index, but draws the index with it backwards towards the bulb. As soon as the temperature begins to rise, the alcohol once more flows past the index towards the farther end of the tube. The end of the index farthest from the bulb remains opposite the mark on the stem indicating the lowest temperature which had occurred since it was last set, and this reading must be taken without touching the thermometer.

To set the index it is only necessary to tilt the bulb end of the tube upwards, when the index will slide down by its own weight until it comes in contact with the inner surface of the end of the column of alcohol.

Care of a Minimum Thermometer.—The chief dangers to which a minimum thermometer are liable are three—(1) the index being shaken into the bulb, (2) the index being shaken partly or wholly out of the column of spirit, and sticking in the tube, and (3) the column of spirit becoming separated or a portion of the spirit evaporating into the upper end of the tube.

The thermometer should be so constructed as to make it impossible for the index to get into the bulb, or with an index so long as not wholly to leave the tube, and this should be seen to before purchasing. When any of the other derangements occurs the natural instinct of

an observer is to immerse the thermometer in warm water until the spirit entirely fills the tube, and then allow it to cool. The only drawback to this simple method is the almost inevitable bursting of the bulb and destruction of the thermometer. This method should never be attempted; but if the warning were not given, the idea would be sure to occur to the observer some time or other, and he would proceed to destroy his thermometer with all the fervour of a discoverer. The only satisfactory way to rectify a deranged minimum thermometer is as follows:

If the column is separated, but the index remains in the spirit, grasp the instrument firmly by the upper end and swing it downwards with a jerk (as in the case of the mercurial thermometer mentioned on p. 28). If the index has been shaken out of the spirit and remains sticking in the upper part of the tube, or if a little spirit has volatilised into the top of the tube and cannot be shaken down by the first method, a quantity of spirit should be passed into the upper end of the tube by grasping the thermometer by the bulb end of the frame and swinging in the same way. When the index is immersed or the drop of volatilised spirit joined on to the column, the first process of swinging by grasping the upper end of the tube will bring the instrument into working order. After any operation of this kind the thermometer should be kept in a vertical position bulb downwards, to allow the spirit adhering to the sides of the tube to drain back completely. Then the thermometer should be brought into the horizontal position and set by allowing the index to slide down to the end of the column of spirit. The end of the column of spirit farther from the bulb should always show the same temperature as the dry-bulb thermometer. If it should be observed to read a degree or two lower, it will be found that some of the spirit has volatilized and condensed at the end of the tube.

The minimum thermometer should be exposed to the air four or six feet from the ground under a screen or roof, like that described on p. 15, so that it is not exposed to the open sky, and the ground under the shelter should be covered with grass or leaves, not on any account left bare. The loss of heat by radiation of the ground to the open sky will produce a night temperature much lower than that of the air a few feet above the ground; and a radiation thermometer is often employed, laid on the grass and exposed to the sky to measure this effect.

Travellers, however, can rarely be expected to make observations of such a kind, as the instrument is one of extreme delicacy.

Maximum Thermometers.—Maximum registering thermometers are filled with mercury, and are less liable to get out of order than spirit-thermometers. The simplest and best form for use by travellers is Negretti and Zambra's. Its principle is very simple. When the temperature rises and the mercury in the bulb expands, it forces its way along the stem in the usual manner; but there is a little constriction in the tube just outside the bulb which breaks the column as the temperature begins to fall, and so prevents the mercury in the bulb from drawing back the thread of mercury from the tube. The thermometer is hung horizontally, and the end of the mercury farthest from the bulb always shows the highest temperature since it was last set. Before reading the thermometer, it is well to take the precaution of seeing that the inner end of the thread of mercury is in contact with the constriction in the tube, and if, by the shaking of the instrument or otherwise, the mercury has slipped away from this position, it should be brought back to it by tilting the thermometer bulb downwards very gently, then returning it to the horizontal position and reading.

To set this thermometer, it is only necessary to hold it vertically bulb downwards and shake it slightly, if necessary striking the lower end of the frame carrying the instrument, gently against the palm of the hand. This causes the mercury to pass the constriction and re-enter the bulb. When set, the end of the column farther from the bulb should indicate the same temperature as the ordinary dry-bulb thermometer.

Another form of maximum thermometer is known as Phillips'. It is an ordinary mercurial thermometer, but a short length of the upper part of the column in the tube is separated from the rest by a little bubble of air. It is used in the horizontal position, and as the temperature rises the whole column moves forward, while, when the temperature falls, only that portion behind the air-bubble retires towards the bulb. The tip of the column thus remains to mark the maximum temperature to which its farther end points. The instrument is set by gently tilting the bulb end downwards, when the detached portion of the column at once runs back until stopped by the air-bubble. This is the most convenient instrument to use at a fixed station; but in travelling it is apt to get out of order as shaking may have the effect of allowing the air-bubble to escape into

the upper part of the tube, or into the bulb, and the instrument cannot easily be brought into working order again.

Rain-Gauge.—While measurements of rainfall can possess no climatological value unless they are carried on continuously at a fixed station, some very interesting observations may be made by the traveller both during the night when in camp, and during heavy showers when compelled to stop on the march. The rain-gauge is in itself the most simple of all scientific instruments, for it consists essentially of a copper funnel to collect the rain as it falls, and a bottle to contain what has been collected. A graduated measuring glass is the only accessory required. Rain is measured by the depth to which the water would lie on level ground if none soaked in, evaporated or flowed away. On an emergency, a rain-gauge can be improvised out of a biscuit tin, or any vessel with vertical sides and an unobstructed mouth. Such a vessel standing level would collect the rain, the depth of which might be measured by an ordinary inch-rule. It is rare, however, to find rain so heavy as to give any appreciable depth when collected in a vessel freely open to evaporation, and in order to estimate the amount of rainfall to small fractions of an inch, the device is employed of measuring the water collected in the receiver of the gauge in a glass jar of much smaller diameter than the mouth of the collecting funnel. Thus, if the funnel exposes a surface of fifty square inches, and the measuring glass has a cross-section of one square inch, the fall of $\frac{1}{50}$ of an inch of rain on the funnel will give a quantity of water sufficient to fill the measuring glass to the depth of an inch. In this way the actual rainfall may be read to the thousandth part of an inch without trouble. The smallest diameter for a serviceable rain-gauge is five inches, and this size is well adapted for the traveller. A three-inch rain-gauge might be employed, but the results obtained with it are not so satisfactory. The rain-gauge should be placed in an open situation, so that it is not sheltered by any surrounding trees or buildings, and it ought to be firmly fixed by placing it between three wooden pegs driven securely into the ground. The mouth of the gauge should be level, and when the instrument is fixed, the rim of the funnel ought to be one foot above the ground. A spare measuring glass should be carried, but as there is always a considerable risk of breaking such fragile objects, it is well to carry also one or two small brass measures of the capacity of half an inch, two-tenths of an inch, and one-tenth of an inch of measured rainfall. In this way,

although no satisfactory record could be kept of light rainfall, a very fair estimate may be made of any torrential showers, the half-inch measure being used first, and then the smaller measures, finally estimating by eye the fraction of the tenth of an inch that remains over. It must, however, be distinctly borne in mind that an estimate formed in this way is not an accurate measurement, and the fact of using the rough method must be stated in the note-book.

When snow falls along with rain, the melted snow is measured as equivalent to rainfall, and if the funnel of the rain-gauge should contain some unmelted snow at the time of observation, it should be warmed until the snow melts before a measurement is taken. When snow falls in a strong wind the drift that occurs makes it almost impossible to measure the amount accurately, but an effort should be made to estimate the average depth of the snow over a considerable area.

If the receiving bottle of the rain-gauge should be broken by frost or accident, any other bottle may be used, or in default of a bottle, the copper case itself will act as a receiver, although the risk of loss by evaporation, and by the wetting of a large surface in pouring out the water, is considerably increased.

At a fixed station the rain-gauge should be read every morning. The traveller who only exposes his rain-gauge during a halt should be careful to state the hours when it was exposed and when it was read.

Barometers.—The barometer is the most delicate, and at the same time the most important, instrument which a meteorologist has to employ. It requires particular care in transport, and must be very carefully mounted and read, while several accessory observations have to be made at each reading in order to ascertain the corrections required for the subsequent calculation of the results. The function of the barometer is to measure the pressure of the air at the time of observation, and this purpose may be carried out by the use of two different principles. The oldest and best method is to measure the height at which a column of heavy fluid is maintained in a tube entirely free from air. The weight of this column is equal to the weight of a column of the atmosphere of the same sectional area. Mercury being the densest fluid is the only one usually employed, because the column balancing a column of the atmosphere of equal sectional area is the shortest that can be obtained, and, consequently, a mercurial barometer is the most portable that can be

constructed on this principle. The mercurial barometer has come to be recognised as the standard in all parts of the world.

The average height of the column of mercury in a barometer is about thirty inches, and, consequently, the whole instrument cannot well be made less than three feet long, so that when account is taken of the glass tube, and the amount of mercury it contains, it is long, fragile and heavy. To avoid the disadvantages inherent in such an instrument, the method of measuring the pressure of the air by the compression of a spring holding apart the sides of an air-free flexible metallic box was devised, and the aneroid barometer invented. The aneroid is graduated on the dial in "inches," i.e., divisions each of which corresponds to a change of atmospheric pressure, equal to that measured by one inch of mercury in a standard barometer. Although a carefully constructed aneroid is a very useful instrument indeed, it is not to be trusted like a mercurial barometer kept in a proper place. But a good aneroid is likely to be much more serviceable to the ordinary traveller on the march than a standard mercurial barometer, every packing and unpacking of which exposes it to the risk of breakage, or to the equally fatal risk of air obtaining access to the vacuous space at the top of the tube. The scale of a barometer may be divided into millimetres, or, as now recommended by the British Meteorological Office, into millibars or thousandths of a hypothetical "atmosphere." We shall describe the Fortin barometer, which is best adapted for use at a fixed station, and one devised by Prof. Collie and Capt. Deasy, which is portable enough for the use of travellers.

The Fortin Barometer.—The barometer must be kept in a room with as equable a temperature as possible; the instrument must be absolutely vertical—hence it should be hung freely and not touched while it is being read; it must be in a good light, and yet be sheltered from the direct rays of the sun. The measurement of the height of any mercurial barometer is that of the difference of level between the surface of the mercury in the tube and the surface of the mercury in the cistern. When the mercury rises in the tube it falls in the cistern, and *vice versa*, although when the cistern is much wider than the tube the changes of level there are much less than those in the tube. In most barometers an arbitrary correction is made to allow for this change, the "inches" engraved on the scale not being true inches. In the Fortin barometer, however, the lower end of the measuring rod is brought in contact with

the mercury in the cistern before every reading, and then the scale of inches engraved on the upper part of the measuring rod gives the true height of the column of mercury. In calculating the barometric pressure for purposes of comparison, five corrections have to be applied: (1) for temperature, which requires the temperature of the barometer at the time of reading to be observed, (2) for altitude, which necessitates knowing the elevation of the place of observation above sea-level, (3) for the force of gravity at sea-level, which requires the latitude to be known, (4) for the capillary attraction between the mercury and the glass tube, which is a constant for each barometer, (5) for the slight imperfection in engraving the scale (index error), which is also a constant for each instrument.

It is enough for the observer at a fixed station, and to such alone can the use of a Fortin barometer be recommended, to read the temperature on the thermometer attached to the barometer and to read the height of the mercury in the barometer tube. These two figures he is to enter in his note-book, and unless he is himself discussing the results, he should apply no correction whatever to them. The rules for observing, then, are:—

1. Read the attached thermometer and note the reading.

2. Bring the surface of the mercury in the cistern into contact with the ivory point which forms the extremity of the measuring rod by turning the screw at the bottom of the cistern. The ivory point and its reflected image in the mercury should appear just to touch each other and form a double cone.

3. Adjust the vernier scale so that its two lower edges shall form a tangent to the convex surface of the mercury. The front and back edges of the vernier, the top of the mercury, and the eye of the observer are then in the same straight line.

4. Take the reading, and enter the observation as read without either correcting it to freezing point or reducing it to the sea-level.

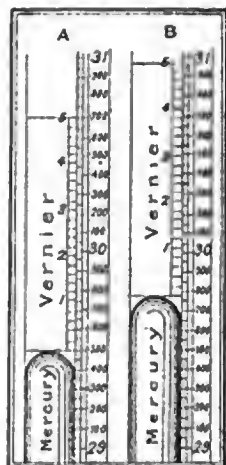


FIG. 5.—Two Readings of the Barometer Vernier.

The scale fixed to the barometer is divided into inches, tenths, and half-tenths, so that each division on this scale is equal to 0.050 inch.

The small movable scale or vernier attached to the instrument enables the observer to take more accurate readings; it is moved by a rick and pinion. Twenty-four spaces on the fixed scale correspond to twenty-five spaces on the vernier; hence each space on the fixed scale is larger than a space on the vernier by the twenty-fifth part of 0.050 inch, which is 0.002. Every long line on the vernier (marked 1, 2, 3, 4, and 5) thus corresponds to 0.010 inch. If the lower edge of the vernier coincides with a line on the fixed scale, and the upper edge with the twenty-fourth division of the latter higher up, the reading is at once supplied by the fixed scale as in A (Fig. 5), where it is 29.500 inches. If this coincidence does not take place, then read off the division on the fixed scale, above which the lower edge of the vernier stands. In B (Fig. 5) this is 29.750 inches. Next look along the vernier until one of its lines is found to coincide with a line on the fixed scale. In B this will be found to be the case with the second line above the figure "2." The reading of the barometer is therefore:—

| | | | |
|---------------------------------|----|----|--------------|
| On fixed scale | .. | .. | 29.750 |
| On vernier ($12 \times .002$) | ∴ | .. | .024 |
| Correct reading | .. | .. | <hr/> 29.774 |

Should two lines on the vernier be in equally near agreement with two on the fixed scale, then the intermediate value should be adopted.

5. Lower the mercury in the cistern by turning the screw at the bottom until the surface is well below the ivory point; this is done to prevent the collection of impurities on the surface about the point.

The transport of barometers requires very great care in order to prevent the introduction of air into the tube or the fracture of the tube by the impact of the mercury against the top. To reduce the risk of these accidents, the barometer must be carried with the tube quite *full of mercury*, and in an inverted position, at least with the cistern end kept higher than the top of the tube. The flexible cistern of the Fortin type of barometer allows of it being screwed up tight so as to fill the tube and close the lower end of it. In case of breakage, the operation of fitting a new tube is not very difficult, but unless the tube has been

carried out ready filled with mercury, this cannot well be attempted. In order to drive out the film of air adhering to the glass on the inside, it is necessary, after filling the tube, to raise its temperature to the boiling-point of mercury. No one should attempt either to fill or to change a barometer tube unless he has had practice in doing so under expert supervision beforehand.

The Collie Portable Mercurial Barometer.—This instrument is not likely to be broken in travelling. It is quickly set up, and from such tests as have been applied, it appears to give excellent results. The cistern and vacuum tube at the top are of equal diameter, and are connected by a flexible tube, and the difference in level of the mercury may be measured directly by means of a graduated rod, or as in Deasy's mounting by means of a vernier. There is no attached thermometer, but if the instrument be used in the open air, and is exposed for ten minutes or a quarter of an hour before using, it will be sufficient to note the temperature of the air in the usual way.

The upper end (Fig. 7) is about 2.5 inches long, and contains an air-trap, into which all the air that may accidentally enter the barometer, either by the tap leaking, through the rubber tubing, or through either of the joints, must find its way. The lower or reservoir end (Fig. 8) is about 4.5 inches long, and has an air-tight glass tap about an inch below the broad part. These ends are forced into the rubber tubing, and, as an additional precaution against leakage, copper wire is bound round the joints. The scale is cut on an aluminium bar, along which two carriages, to which the barometer is attached, move up and down, and they can be clamped to the bar at any place (Fig. 6). By means of the verniers attached to the carriages, which are divided to 0.002 of an inch, it is easy to estimate the height of the mercury to 0.001.

To use the barometer, the carriages are put on the scale bar; the lower one is clamped at the bottom of the bar, and the upper one some inches higher up; the barometer is attached to the carriages by clamps which fit over the joints; the rubber cap is removed from the reservoir end, the tap opened, the verniers put in the middle of their runs, and the upper carriage moved up the bar until there is a vacuum. By means of the screws on the right of the carriages the verniers are moved up or down until the top of the mercury at each end is in line with the edges of the rings attached to the verniers, which fit round the glass ends. Both verniers are then read, and the difference gives the height of the baro-

meter. The rubber cap on the reservoir end is merely to prevent the small quantity of mercury, which should be left above the tap when it



FIG. 6.

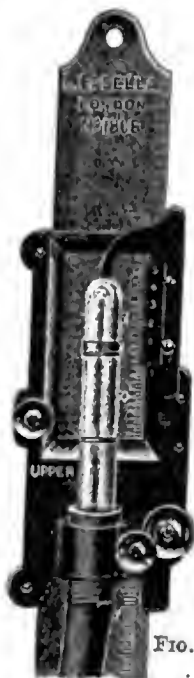


FIG. 7.

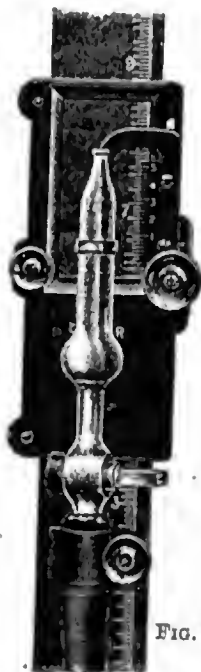


FIG. 8.

FIG. 6. THE COLLIE BAROMETER, WITH THE DEASY MOUNTING, IN ITS NORMAL WORKING POSITION.

FIG. 7. THE UPPER CARRIAGE AND VERNIER ON A LARGER SCALE, WITH BAROMETER ATTACHED.

FIG. 8. THE LOWER CARRIAGE AND VERNIER, WITH RESERVOIR END OF BAROMETER ATTACHED. (Same scale as Fig. 7.)

is closed, from being shaken out when travelling.

To pack up the barometer, lower the upper carriage *very slowly* until the mercury has touched the top of the glass; then detach the barometer

from this carriage, and either let the upper end hang vertically below the reservoir, or detach the reservoir end from its carriage and raise it till the barometer hangs vertically. By this means the barometer is completely filled with mercury, and then the tap must be closed. The tube is then to be coiled away in its padded box. When too much air is found in the trap, it must be extracted by means of the air-pump.

The Aneroid Barometer.—The aneroid barometer is so convenient on account of its portability that, although much less trustworthy than a mercurial barometer, it is much more likely to be used by a traveller. Care should be taken in using it to see that the pointer has come to a position of equilibrium, and it should be tapped gently before reading. The eye must be brought directly over the end of the pointer, and the reading made to one-hundredth of an inch, the barometer being held in a horizontal position. Every opportunity of comparing the aneroid with a standard mercurial barometer should be taken, and a note made of the readings of both. The mercurial barometer will require to be corrected for temperature before its indications can be used for correcting the aneroid, as all good aneroids are compensated for changes of temperature. The readings of an aneroid give a very fair idea of the changes of atmospheric pressure, and are very much better than none at all, although they cannot in any case be accepted as of the highest order of accuracy.

The Watkin mountain aneroid, which is so constructed as to be thrown into gear at the moment when it is read, appears to be free from the worst errors of the ordinary aneroid.

For climatological purposes, it is impossible to make barometric observations of value while travelling unless the altitude of each camping-place is accurately known. This is practically never the case except when travelling along the sea-shore or the margin of a great lake the elevation of which has been determined. But, meteorology apart, barometric readings in any little known country are of value, because by comparing them with simultaneous readings taken at a neighbouring fixed station, new data as to the altitude of the country may be obtained. While in camp, it would be an extremely useful thing to make barometer readings, even with an aneroid, every two hours, in order to get some information as to the normal daily range of atmospheric pressure.

The Boiling-point Thermometer.—The temperature at which water boils depends on the pressure of the atmosphere, so that an accurate observa-

tion of the boiling-point of water enables the pressure of the atmosphere at the moment of observation to be determined with the utmost accuracy. This method of determining atmospheric pressure having been used hitherto almost solely for the purpose of measuring altitudes, the boiling-point thermometer is usually known as the Hypsometer, but its records are quite as valuable for use at fixed stations as in mountain climbing. Mr. J. Y. Buchanan recommends the use of a boiling-point thermometer with a very open scale graduated to fiftieths of a degree Centigrado and entirely enclosed in a wide glass tube through which steam from water boiling in a copper vessel is passing. On a thermometer of this kind change of pressure can be measured by the change of boiling-point more accurately than with the aid of a mercurial barometer. See Table, Vol. I., p. 298.

2. OBSERVATIONS FOR FORECASTING THE WEATHER.—The familiar name of "weather-glass" is appropriately applied to the barometer, for in most parts of the world it is the surest indicator of any approaching storm.

The scientific prediction of the weather by means of the barometer involves the comparison of the simultaneous readings of barometers over as wide an area as possible, and can only be carried out where there is a complete telegraph system and a public department charged with the work. The storms of wind and rain which break the more usual steady weather are usually associated with the formation of centres of low atmospheric pressure towards which wind blows in from every side. These atmospheric depressions move, as a rule, in fairly regular tracks, the rate of movement of the centre of the depression having no relation to the rate at which the wind blows or to the direction of the wind. The term *cyclone* is usually applied to such a moving depression, because of the rotating winds round the centre; but the size of a cyclone may vary from a vast atmospheric eddy extending across the whole breadth of the Atlantic to one only a few miles in diameter. The strength of the wind in a cyclone depends on the barometric gradient; in other words, the greater the difference in atmospheric pressure between two neighbouring points the stronger is the wind that blows between them. Or, when a cyclone is passing over an observer, the more rapidly the barometer falls or rises the stronger may the wind be expected to blow.

In direct contrast to the cyclone or depression is the system of high pressure rising to a centre from which the wind blows out on every side.

This is called an anticyclone, and is a condition which, once established, may last for many days, or even weeks, without change. It is the typical condition for dry calm weather in all parts of the world.

The direction of movement of the centres of cyclones in the northern hemisphere is usually westward and northward near the equator, the path of the centre bending to the right as it proceeds, and becoming ultimately eastward and southward. In the southern hemisphere the direction of the centre near the equator is westward and southward, turning towards the left as it proceeds. The rotation of the wind about the centre of a cyclone in the northern hemisphere is inwards towards the centre in the direction opposite to the hands of a watch, and in the southern hemisphere it is in the direction in which the hands of a watch move (Fig. 9). In the centre of a cyclone there is a calm, a well-known danger to sailing ships caught in such a storm at sea, because there is no wind to move the vessel, but a tremendous sea driven in from the gale which rages all round from every point of the compass. The law of storms has been very fully studied, and rules have been drawn up to enable sailors to ascertain the direction in which the centre of an approaching cyclone lies and the direction in which it is moving. In a work intended mainly for travellers on land it is not necessary to give these rules; all that is required is to tell how the approach of dangerous storms may be ascertained some time in advance. The fact that the barometer is high or low is in itself of no value for prediction. The important thing to know is the distribution of atmospheric pressure at a given moment over a considerable area.

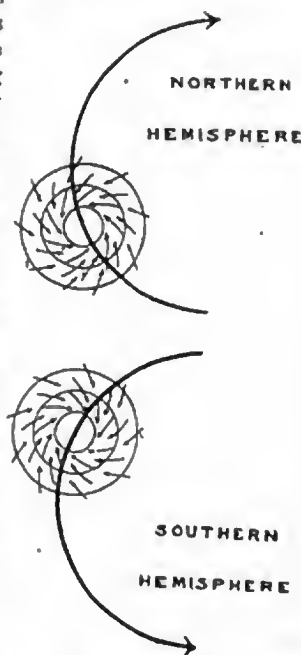


FIG. 9.—CYCLONE PATHS AND CIRCULATION OF WINDS IN CYCLONES IN THE NORTHERN AND SOUTHERN HEMISPHERES.

To the isolated observer this is impossible, and he can only judge of the state of the atmosphere by observing the *rate* at which the barometer is falling or rising. Thus, if for several days the barometer has been steadily and slowly rising, he will probably be right in believing that an anticyclonic condition is establishing itself, and that the weather may be expected to continue fine for many days to come, even after a gradual fall of the barometer begins. A sudden fall of the barometer, on the other hand, is always a sign of wind, and usually of wet weather as well. This is a particularly valuable sign of approaching storm in those parts of the world where, as in the tropics, the normal weather is very uniform and steady. In such places a very sudden fall, say one-tenth of an inch in an hour, is a sure precursor of a violent storm. As the barometer continues to fall, the wind will probably continue to increase in force, and when the barometer reaches its lowest point it will either fall calm (if the centre of the cyclone is passing over the observer) or suddenly change in direction. The rapid rise of the barometer after a great depression is also always accompanied by strong wind, though not so frequently by rain.

It must be clearly understood that these remarks refer only to observations at a fixed station. If a fall of barometer is observed in travelling, it may be due either to a change in the state of the atmosphere or to a change in the traveller's height above sea-level. This is the reason why it is absolutely essential, in making barometric estimates of height (or boiling-point determinations), to have simultaneous observations going on at a base-station, or preferably at a series of intermediate stations.

The ordinary prognostics of the approach of rain or bad weather differ in different localities, and require a considerable amount of local knowledge before they can be utilised. The peculiar absorption band in the solar spectrum due to the water vapour of the Earth's atmosphere, and called the rain-band, is a valuable guide to an experienced observer with a spectroscope in predicting rain. The only instrument, however, likely to be useful to the ordinary traveller is the wet and dry bulb thermometer. When the two thermometers have the same reading, indicating saturation of water vapour, or when they approach at temperatures above 60° F. within two degrees or so, rain may be expected, or possibly mist. The appearance of low clouds clinging to the hillsides is an indication that the temperature at the place where they are is below the dew-point. The

appearance of the upper clouds, taken in conjunction with the readings of the barometer, is a valuable indication of forthcoming weather changes. The increase of cirrus clouds in a clear sky with a falling barometer, or the appearance of a solar or lunar halo, may be taken as a sure sign of an approaching cyclone, the intensity of which may be foreseen by the rate at which the barometer is falling.

While the weather of places on the west coasts of temperate continents exposed to the prevailing sea-wind is usually made up of a succession of cyclones of different degrees of intensity, and of the anticyclonic intervals between them, over the greater part of the Earth's surface the climate is much more uniform, and the seasonal changes are the principal cause of changes of weather. To understand these general conditions it is necessary to consider the elements of climatology.

8. **OUTLINES OF CLIMATOLOGY.**—The air is in constant movement on account of the unequal way in which the heat of the sun falls on different parts of the Earth's surface, and at different seasons of the year. All the conditions of the atmosphere show a certain diurnal periodicity which is most marked in the regions of steady climate between and near the tropics. Thus, as a rule, the minimum temperature of the air occurs just before sunrise, the maximum temperature from two to three hours after noon. The amount of difference between the maximum and minimum temperature of the day (daily range) is least near the sea or in wet regions (a maritime climate) and greatest in the interior of the continents, especially where the rainfall is slight (a continental climate). Over the sea itself the daily range of air temperature averages only 8 Fahrenheit degrees; but in the heart of a continent, especially in a desert, it may exceed 60 Fahrenheit degrees.

Diurnal changes of pressure are proportionally much smaller in amount than changes of temperature, and are to be observed as a regular phenomenon only in the tropics, or elsewhere during very settled weather. There are usually two maxima daily, about 10 A.M. and 10 P.M., and two minima occurring about 4 A.M. and 4 P.M. It is only in rare cases that the total barometric range exceeds 0.10 inch, very frequently it is not greater than 0.04 inch. Still it is convenient to remember in the tropics that a fall of the barometer not greater than 0.10 inch between 10 A.M. and 4 P.M. is to be expected, and does not indicate either the approach of a storm (if the observer is at rest) or the ascent of 100 feet (if he is on the march).

Associated with the diurnal changes of temperature in settled weather are changes of wind due to local configuration of the ground. The wind, for example, usually blows up a mountain side, or up a steep valley, during the day, and down a mountain, or down a steep valley, during the night. So, too, the regular land and sea breezes found on the borders of the sea or of great lakes blow from water to land in the day time and from land to water at night. Here the determining cause is the fact that land is warmed and cooled by radiation, and in turn heats or chills the air much more than water does. In the settled climates of high tropical plateaus a regular diurnal change of wind direction has been observed, the wind blowing successively from all points of the compass.

A similar diurnal periodicity occurs in the amount of cloud, in the moisture of the air, the fall of rain, the occurrence of thunderstorms, etc. It is also to be noticed in the flow of rivers in mountainous regions where the streams take their rise from glaciers or snow, the rapid melting of which by the heat of the sun causes the volume of water to increase greatly in the afternoon, while the cessation or reduction of the rate of melting at night diminishes the volume of the river in the morning and forenoon.

Periodic changes of greater amount but similar in kind are produced by the alternation of the seasons, the difference between the mean values of the months in which the phenomena are at a maximum and minimum respectively being termed the annual range. With regard to temperature, very moderate changes occur in the tropical zones where the altitude of the noon-day sun is always great, and the length of day and night varies little with the season (for the most part less than 5 Fahrenheit degrees); but in the temperate and frigid zones there are strongly marked annual changes. As in the case of daily range, proximity to the sea is a controlling factor in the annual range of temperature. To take a very characteristic instance, the annual range between the mean temperature of July and January is about 23 Fahrenheit degrees in the Lofoten islands on the margin of the Atlantic, while it is 120 Fahrenheit degrees at Verkhoyansk in the same latitude, but in the centre of the Asiatic continent.

The extreme months for air temperature are January and July in almost every part of the world, the maximum occurring north of the equatorial belt in July and south of it in January.

The annual changes in barometric pressure and wind are equally marked. The belt of low pressure which lies nearly under the vertical sun moves northward over the surface of the globe in the northern

summer, coming to its most northerly position in July: returning southward after the sun, it reaches its most southerly position in January. This belt of low pressure is also a belt of calms, known by sailors as the Doldrums, and it is a belt of frequent rains, so that as it approaches and passes over a place there is a rainy season, followed by a dry season when it retires. Near the mean position of the belt of low pressure, where it passes over a place twice in the year, there are two rainy seasons. The low pressure belt is bordered to north and south by belts of high atmospheric pressure, from which the trade-winds blow towards the equator, and the westerly anti-trades blow towards the poles. These are also subject to the annual change; but the different action of land and sea on the distribution of pressure exercises a greater influence than does the difference of latitude. As the greater heating and cooling of the land each day causes the phenomena of daily land and sea breezes, so the greater heating and cooling of the land between summer and winter causes seasonal land and sea winds, blowing from land to sea in winter, from sea to land in summer. Generally speaking, the pressure is greater—in the same latitude—where the air is cooler, so that outside the frigid zones cold areas are usually areas of high pressure, from which wind blows out in every direction, while warm areas are areas of low pressure towards which wind blows in on every side.

The distribution of rainfall on the land is dependent on the direction of the rain-bringing wind and the configuration of the surface. Thus when the rain-bringing wind meets a mountain range, it deposits a great rainfall on the exposed slopes, but passes over as a dry wind which yields little rain to the region beyond. In places where the wind changes with the season, as in southern Asia, the distribution of rainfall is entirely different during the continuance of the different monsoons.

All these questions of normal climate can be more easily illustrated on maps than explained by words. But the reader must be cautioned against taking the condensed and generalised representations of small-scale maps as showing all that is known on the subject. Even the magnificent plates in the 'Atlas of Meteorology,' which forms part of Bartholomew's Physical Atlas, cannot show everything that is known; and in many parts of the world so little has yet been ascertained as to the climatic conditions that generations of observers will be required to make it possible for meteorologists to draw a uniform trustworthy map of the whole world showing the distribution of any one element of climate.

Isothermal maps.—The principle of an isothermal map is that of representing the distribution of temperature by drawing lines through all the places where the temperature is the same at a given time. It is usual to take this time as an average month in an average year. Thus in a map of isotherms for January (see p. 50), what is shown is not the temperature of any particular day in any particular January, but that of an average day in a long series of Januaries. Hence it is not likely that the *exact* distribution of temperature shown in the map will ever be found on any January day; but it is to be expected that most days in every January will have a distribution of temperature which is very similar to that shown. The same is of course true of maps showing pressure, or rainfall, or any other average condition.

Again, the isotherm is necessarily constructed from average temperatures which have been corrected so as to be applicable to the same level. On the equator, for instance, the summit of a lofty mountain is seen by the snow on it to have a temperature not exceeding 32° F., while at sea-level the temperature may be 90° . But observations have been made showing the rate at which the temperature of the air diminishes as the height increases, and although the rate varies in different places and at different seasons, it may be taken roughly as one Fahrenheit degree in 300 feet. Now if the mountain top with a temperature of say 80° F. is known to be 18,000 feet above the sea, the addition of 1° for every 300 feet, or 60° altogether, would give the temperature of 90° as that corresponding to sea-level. By applying such corrections, the isothermal maps have been constructed to show the distribution of temperature at the level of the sea. In order to compare the temperature he has observed with that on the map the observer must calculate the average of his daily observations for the month in question, and then make the correction for the altitude of his station.

Similarly, in ascertaining from an isothermal map the mean temperature of a particular place, care must be taken to subtract from the number of degrees of the isotherm passing through the place one degree for every 300 feet of elevation. Of course it will usually happen that no isotherm as shown on the map runs through the point the mean temperature of which it is desired to obtain. In that case the temperature at the point will be found by considering its relative position between the two nearest isotherms. Thus, if it lie half-way between the lines of 60° and 70° —measured perpendicularly to the isotherms—the temperature of 65° may

be assumed; if it lies one-tenth of the distance from 60° and nine-tenths from 70° , it is safe to assume 61° ; if three-tenths from 70° and seven-tenths from 60° , then assume 67° . If the point lie in a loop of a single isotherm, *e.g.*, Cape St. Roque, the eastern point of South America in the map for January, lying within the 80° isotherm, one can only guess that the temperature is above 80° and it may be assumed to be below 85° . The method of representation is unsatisfactory in such a case.

These facts being borne in mind, the study of isotherm maps will be found to give an excellent general idea of the distribution of climate at sea-level, and if the contour lines of 600 and 6000 feet are traced on the maps the areas within which corrections of over -2° and -20° have to be applied to the isothermal values to get the temperature at the place will be easily recognised.

Isobaric Maps.—Isobars are drawn from the data of the height of the barometer corrected to sea-level values and to the temperature of 82° F., exactly in the same way as isotherms are drawn from the data of thermometer readings or contour lines from data of altitude measurements. The practical value of the study of isobars is very great, because of the importance of assuming a probable value of sea-level pressure in reducing the barometric or boiling-point thermometer readings for determining elevation, and also because of the intimate relation between the form and proximity of isobars and the direction and force of the winds.

Barometric gradient is measured by the difference between the isobars per unit of length. For instance, gradient is frequently expressed in the number of hundredths of an inch difference between barometers fifteen nautical miles apart. The greater the gradient of pressure is, the more closely together must the isobars be drawn in order to represent it. For example, in the isobaric map for January (p. 50) a very steep gradient is shown on the east coast of Asia, north of Japan, and a remarkably gentle gradient in the interior of Asia from the Black Sea eastward. The steeper the gradient the stronger is the wind.

The arrows in the isobaric maps (which are represented flying with the wind) show the average directions of the wind over the world for the months in question. The relation they bear to the isobars becomes clear on inspection, although, on account of the greater number of observations available for some parts of the world than for others, all the arrows are not drawn with the same amount of certainty, and the direction of a

few contradicts that of most. As a general rule, the following facts may be taken as absolutely established: (1) Wherever there is a region of high pressure the wind blows out from it in all directions. (2) Wherever there is a region of low pressure the wind blows in towards it from every side. (3) The wind never blows perpendicularly to the isobars or directly from higher to lower pressure, but always in a curved or spiral path inclined to the isobars. (4) In the northern hemisphere the wind blows out from a high pressure area in the same direction as the hands of a watch move, but in the southern hemisphere in the opposite direction. Also in the northern hemisphere the wind blows into a low-pressure area in the direction opposite to that of the hands of a watch and in the southern hemisphere in the same direction as the hands of a watch move. (5) Recognising that the wind blows nearly parallel to the direction of the isobars, the following statement (known as Buys Ballot's Law) expresses its direction both for high-pressure and for low-pressure areas: If you stand with the lower pressure on your left hand, and the higher pressure on your right hand, in the northern hemisphere the wind will be blowing on your back, but in the southern hemisphere in your face.

Rainfall Maps.—Rainfall is represented on maps by lines of equal precipitation termed Isohyets. These represent actual figures without reduction for elevation or other local conditions, and a rainfall map can consequently be studied as a direct record of observed facts. The map (p. 50) of mean annual rainfall brings out clearly the equatorial zone of heavy rains crossing the Amazon valley, the Congo valley, the south-eastern peninsulas of Asia and the Malay archipelago. North and south of this belt are the nearly rainless regions of the tropical deserts, extended northward and southward over the continents, and merging nearer the poles into the fairly-watered temperate zones. The rainfall maps for separate months show the intimate relation between rainfall and the direction of the wind taken in conjunction with the configuration of the land. Even on the coast, when the prevailing wind is off shore, there may be scarcely any rain, as on the west coast of tropical South America. In the very heart of a continent the rainfall may be very heavy where the sea-wind blows across a great plain before striking the mountains, as is illustrated by the eastern slope of the Andes. Rainfall is, however, one of the most inconstant elements of meteorology, and the actual rainfall of any year may differ very widely from the average. The practical

value of exact statistics of rainfall is, however, greater than that of any other climatological epudition; for the water supply and the fertility of the land depend in every case on the rain that falls either locally or on the heights of the water-sheds.

In order to pursue the subject further the chapters on the atmosphere in the writer's 'Realm of Nature' (London, Murray; New York, Scribner) and Mr. L. C. W. Bonacium's 'Climatic Control' (London, A. and C. Black) may be useful. The most systematic treatment of climatology will be found in Hann's 'Handbuch der Klimatologie,' 8 vols. (Stuttgart), which contains numerous references to special works; the essential part of this treatise is translated by Professor H. de C. Ward, under the title of 'Handbook of Climatology,' Part I. (Macmillan). The most important work of all is the great 'Atlas of Meteorology' by Dr. A. Buchan and Dr. A. J. Herbertson, forming Vol. III. of Bartholomew's 'Atlas of Physical Geography' (London, Constable), which gives an unrivalled series of climate and weather-maps with explanatory letterpress.

The recent great advances in meteorology have rendered the old textbooks obsolete, while the new data, especially those regarding the upper regions of the atmosphere, have not yet been built into a coherent system. Sir Napier Shaw's 'Forecasting Weather' (London, Constable & Co.) is a pioneer discussion, and the numerous publications of the Meteorological Office, South Kensington, London, S.W. 7, may be consulted with much advantage.

Daily synoptical weather-maps are published by the Weather Service of almost every civilised country. Those for the United Kingdom may be obtained from the Meteorological Office of the Air Ministry. The only weather-maps of large areas produced regularly are the Pilot Charts of the North Atlantic and the North Pacific, published monthly by the Hydrographic Office at Washington, and those of the North Atlantic and Mediterranean published monthly by the Meteorological Office in London. These show the tracks of cyclones, and give a great deal of information as to the meteorology and currents of the oceans. They are intended primarily for the use of sailors.

The following list gives the name of the official weather service of all countries outside Europe and the town in which the head office is situated. Application might be made to any of these offices for information as to the stations where standard instruments are established in the country in question.

EXTRA-EUROPEAN WEATHER SERVICES.

| Country. | Name. | Place. |
|----------------------------------|---|-----------------|
| <i>America :—</i> | | |
| Canada | Meteorological Service of the Dominion of Canada | Toronto. |
| United States and West Indies .. | Weather Bureau | Washington. |
| Mexico | Observatorio meteorologico magnetico central | Mexico. |
| Salvador | Observatorio Astronomico y Meteorologico | San Salvador. |
| Guatemala | Instituto fisico-geografico | San José. |
| Cuba | Real Colegio de Belen de la compania de Jesus | Havana. |
| Brazil | Central Meteorological Department of the Navy | Rio de Janeiro. |
| Uruguay | Observatorio meteorologico del colegio pio de Villa Colon | Montevideo. |
| Argentina | Oficina meteorologica Argentina | Buenos Aires. |
| Chile | Oficina meteorologica | Santiago. |
| Peru | Harvard College Observatory | Arequipa. |
| <i>Africa :—</i> | | |
| Algeria | Service météorologique | Algiers. |
| British Central Africa | | Zomba. |
| Egypt | Observatory | Helwan. |
| Madagascar | Observatoire | Tananarivo. |
| Mauritius | Royal Alfred Observatory | Pamplemousses. |
| Union of South Africa | Meteorological Branch, Irrigation Department | Johannesburg. |
| <i>Asia :—</i> | | |
| India | Meteorological Department | Calcutta. |
| Japan | Central Meteorological Observatory .. | Tokyo. |
| Ceylon | Surveyor-General's Office | Colombo. |
| Hongkong | Observatory | Hongkong. |
| China | Imperial Maritime Customs | Peking. |
| Philippine Islands .. | Observatoire de Zi-ka-wei | Shanghai. |
| Dutch East Indies .. | Weather Bureau | Manila. |
| | Magnetic and Meteorological Observatory | Batavia. |

EXTRA-EUROPEAN WEATHER SERVICES—*continued.*

| Country. | Name. | Place. |
|----------------------------------|--|-------------|
| <i>Australasia and Pacific:—</i> | | |
| Australia | { Commonwealth Meteorological Ser- vice } | Melbourne. |
| New Zealand .. | Meteorological Office | Wellington. |
| Hawaii | Weather Bureau | Honolulu. |

In addition to the above, which are regular government services specially organised for publishing and utilising the data from numerous observing stations, there are many isolated stations in all parts of the world. There are no colonies which do not possess some meteorological stations, and at many mission stations meteorological observations are made. It would always be well for a traveller to try to ascertain where in the vicinity of his route meteorological stations have been established and over what period of time their records extend.

In the Table (pp. 44-49), taken from Marriott's "Hints to Meteorological Observers," is given the relative humidity for every 2° of temperature from 20° to 80° , and for every two-tenths of a degree of difference between the dry and wet-bulb readings from $0^{\circ}\cdot 2$ to $18^{\circ}\cdot 0$.

To use the Table: Look in the column on the left or right for the nearest degree to the dry-bulb reading; then carry the eye horizontally along until the column is reached corresponding to the difference between the readings of the dry and wet-bulb thermometers, when the relative humidity will be found. Intermediate readings can be interpolated in the usual way.

Example: Dry-bulb $58^{\circ}\cdot 5$, wet-bulb $52^{\circ}\cdot 7$, the difference is $5^{\circ}\cdot 8$. Having found 58° in the column on the left or right, run the eye along this line until the column under $5^{\circ}\cdot 8$ is reached, when the relative humidity will be found, viz., 67.

TABLE OF

| Dry Bulb Reading. | DIFFERENCE BETWEEN THE READINGS OF | | | | | | | | | | | | | | |
|----------------------|------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 | 2.8 | |
| 0 | | | | | | | | | | | | | | | |
| 20 | 91 | 86 | 80 | 74 | 68 | 63 | 59 | 55 | 51 | 47 | 44 | 41 | 37 | 34 | |
| 22 | 94 | 88 | 82 | 76 | 70 | 65 | 60 | 56 | 51 | 50 | 47 | 44 | 41 | 38 | |
| 24 | 94 | 88 | 83 | 78 | 73 | 69 | 65 | 61 | 57 | 51 | 50 | 47 | 44 | 41 | |
| 26 | 95 | 90 | 85 | 80 | 76 | 72 | 68 | 64 | 61 | 57 | 54 | 51 | 48 | 45 | |
| 28 | 96 | 92 | 88 | 84 | 80 | 76 | 72 | 69 | 66 | 63 | 60 | 57 | 54 | 52 | |
| 30 | 96 | 93 | 90 | 87 | 84 | 81 | 78 | 75 | 72 | 70 | 67 | 64 | 62 | 60 | |
| 32 | 97 | 94 | 91 | 89 | 87 | 84 | 82 | 80 | 78 | 76 | 73 | 71 | 69 | 67 | |
| 34 | 97 | 95 | 93 | 91 | 89 | 87 | 85 | 83 | 81 | 80 | 78 | 76 | 74 | 72 | |
| 36 | 98 | 96 | 94 | 93 | 91 | 89 | 87 | 86 | 84 | 82 | 80 | 79 | 77 | 76 | |
| 38 | 98 | 96 | 94 | 93 | 91 | 89 | 87 | 86 | 85 | 83 | 81 | 80 | 78 | 77 | |
| 40 | 98 | 97 | 95 | 94 | 92 | 90 | 88 | 87 | 86 | 84 | 82 | 81 | 79 | 78 | |
| 42 | 98 | 97 | 95 | 94 | 92 | 90 | 88 | 87 | 86 | 84 | 82 | 81 | 80 | 78 | |
| 44 | 98 | 97 | 95 | 94 | 92 | 90 | 88 | 87 | 86 | 84 | 82 | 81 | 80 | 78 | |
| 46 | 99 | 97 | 95 | 94 | 92 | 91 | 89 | 88 | 87 | 85 | 83 | 82 | 81 | 79 | |
| 48 | 99 | 97 | 95 | 94 | 92 | 91 | 89 | 88 | 87 | 85 | 84 | 82 | 81 | 80 | |
| 50 | 99 | 97 | 96 | 94 | 93 | 92 | 90 | 89 | 88 | 86 | 85 | 83 | 82 | 81 | |
| 52 | 99 | 97 | 96 | 94 | 93 | 92 | 90 | 89 | 88 | 86 | 85 | 83 | 82 | 81 | |
| 54 | 99 | 97 | 96 | 94 | 93 | 92 | 90 | 89 | 88 | 86 | 85 | 83 | 82 | 81 | |
| 56 | 99 | 97 | 96 | 94 | 93 | 92 | 90 | 89 | 88 | 86 | 85 | 83 | 82 | 81 | |
| 58 | 99 | 97 | 96 | 94 | 93 | 92 | 90 | 89 | 88 | 87 | 85 | 84 | 83 | 82 | |
| 60 | 99 | 97 | 96 | 94 | 93 | 92 | 90 | 89 | 88 | 87 | 85 | 84 | 83 | 82 | |
| 62 | 99 | 98 | 96 | 95 | 94 | 93 | 91 | 90 | 89 | 88 | 86 | 85 | 84 | 83 | |
| 64 | 99 | 98 | 96 | 95 | 94 | 93 | 91 | 90 | 89 | 88 | 86 | 85 | 84 | 83 | |
| 66 | 99 | 98 | 96 | 95 | 94 | 93 | 91 | 90 | 89 | 88 | 86 | 85 | 84 | 83 | |
| 68 | 99 | 98 | 96 | 95 | 94 | 93 | 92 | 91 | 90 | 89 | 87 | 86 | 85 | 84 | |
| 70 | 99 | 98 | 95 | 95 | 94 | 93 | 92 | 91 | 90 | 89 | 87 | 86 | 85 | 84 | |
| 72 | 99 | 98 | 95 | 95 | 94 | 93 | 92 | 91 | 90 | 89 | 87 | 86 | 85 | 84 | |
| 74 | 99 | 98 | 95 | 95 | 94 | 93 | 92 | 91 | 90 | 89 | 87 | 86 | 85 | 84 | |
| 76 | 99 | 98 | 97 | 96 | 95 | 94 | 93 | 92 | 91 | 90 | 88 | 87 | 86 | 85 | |
| 78 | 99 | 98 | 97 | 96 | 95 | 94 | 93 | 92 | 91 | 90 | 88 | 87 | 86 | 85 | |
| 80 | 99 | 98 | 97 | 95 | 95 | 94 | 93 | 92 | 91 | 90 | 89 | 87 | 86 | 85 | |

RELATIVE HUMIDITY.

| THE DRY AND WET BULB THERMOMETERS. | | | | | | | | | | | | | | | Dry Bulb Reading. |
|------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----------------------|
| 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | |
| 32 | 29 | 27 | 25 | 23 | 21 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 20 |
| 36 | 31 | 28 | 26 | 24 | 22 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 22 |
| 39 | 36 | 34 | 32 | 30 | 29 | 27 | 25 | 23 | 21 | 19 | 18 | 17 | 16 | 15 | 24 |
| 43 | 41 | 39 | 37 | 35 | 33 | 31 | 29 | 27 | 26 | 25 | 23 | 21 | 20 | 19 | 26 |
| 50 | 48 | 46 | 44 | 42 | 40 | 38 | 36 | 34 | 33 | 32 | 30 | 29 | 27 | 26 | 28 |
| 58 | 55 | 53 | 51 | 49 | 47 | 45 | 44 | 42 | 40 | 39 | 37 | 36 | 35 | 33 | 30 |
| 65 | 63 | 61 | 60 | 58 | 57 | 54 | 53 | 51 | 50 | 48 | 47 | 45 | 44 | 42 | 32 |
| 71 | 69 | 67 | 65 | 63 | 62 | 60 | 59 | 57 | 56 | 55 | 53 | 52 | 51 | 50 | 34 |
| 74 | 72 | 71 | 69 | 68 | 66 | 64 | 63 | 61 | 60 | 59 | 58 | 57 | 55 | 54 | 36 |
| 76 | 74 | 73 | 71 | 70 | 69 | 67 | 66 | 64 | 63 | 62 | 61 | 60 | 58 | 57 | 38 |
| 76 | 75 | 74 | 72 | 71 | 70 | 68 | 67 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 40 |
| 77 | 76 | 75 | 73 | 72 | 70 | 69 | 68 | 66 | 65 | 64 | 63 | 62 | 61 | 60 | 42 |
| 78 | 77 | 76 | 74 | 73 | 72 | 71 | 70 | 68 | 67 | 65 | 64 | 63 | 62 | 61 | 44 |
| 78 | 77 | 76 | 74 | 73 | 72 | 71 | 70 | 68 | 67 | 66 | 65 | 64 | 63 | 62 | 46 |
| 79 | 78 | 77 | 75 | 74 | 73 | 72 | 71 | 69 | 68 | 67 | 66 | 65 | 64 | 63 | 48 |
| 79 | 78 | 77 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 66 | 65 | 64 | 63 | 50 |
| 80 | 79 | 78 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 67 | 66 | 65 | 64 | 52 |
| 80 | 79 | 78 | 77 | 76 | 75 | 73 | 72 | 71 | 70 | 69 | 68 | 67 | 66 | 65 | 54 |
| 81 | 80 | 79 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 67 | 66 | 56 |
| 82 | 81 | 80 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 67 | 58 |
| 82 | 81 | 80 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 67 | 60 |
| 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 62 |
| 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 64 |
| 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 66 |
| 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 |
| 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 70 |
| 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 72 |
| 84 | 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 74 |
| 84 | 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 76 |
| 85 | 84 | 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 78 |
| 85 | 84 | 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 80 |

TABLE OF RELATIVE

| Dry Bell Reading. | DIFFERENCE BETWEEN THE READINGS OF | | | | | | | | | | | | | | |
|-------------------|------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 6.0 | 6.2 | 6.4 | 6.6 | 6.8 | 7.0 | 7.2 | 7.4 | 7.6 | 7.8 | 8.0 | 8.2 | 8.4 | 8.6 | 8.8 |
| 20 | 10 | 9 | 8 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | .. | .. | .. | .. |
| 22 | 11 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 5 | 5 | 4 |
| 24 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 6 |
| 26 | 18 | 17 | 16 | 15 | 14 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 9 | 8 | 8 |
| 28 | 25 | 24 | 23 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 15 | 14 | 14 | 13 | 13 |
| 30 | 32 | 31 | 30 | 29 | 28 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 |
| 32 | 41 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 29 | 28 | 27 |
| 34 | 49 | 47 | 46 | 45 | 44 | 43 | 41 | 40 | 39 | 38 | 37 | 36 | 36 | 35 | 34 |
| 36 | 53 | 52 | 51 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 39 |
| 38 | 55 | 55 | 54 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 42 |
| 40 | 58 | 57 | 56 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 44 |
| 42 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 |
| 44 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 |
| 46 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 |
| 48 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 |
| 50 | 62 | 61 | 60 | 59 | 58 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 |
| 52 | 63 | 62 | 61 | 60 | 59 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 |
| 54 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 |
| 56 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 |
| 58 | 66 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 |
| 60 | 66 | 65 | 64 | 63 | 62 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 |
| 62 | 67 | 66 | 65 | 64 | 63 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 |
| 64 | 68 | 67 | 66 | 65 | 64 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 |
| 66 | 68 | 67 | 66 | 65 | 64 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 |
| 68 | 69 | 68 | 67 | 66 | 65 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 |
| 70 | 69 | 68 | 67 | 66 | 65 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 |
| 72 | 70 | 69 | 68 | 67 | 66 | 66 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 |
| 74 | 70 | 69 | 68 | 67 | 66 | 66 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 |
| 76 | 71 | 70 | 69 | 68 | 67 | 66 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 |
| 78 | 71 | 70 | 69 | 68 | 67 | 67 | 66 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 58 |
| 80 | 72 | 71 | 70 | 69 | 68 | 67 | 67 | 66 | 65 | 64 | 63 | 62 | 61 | 60 | 59 |

HUMIDITY.—Continued.

| THE DRY AND WET BULB THERMOMETERS. | | | | | | | | | | | | | | | Dry Bulb Reading |
|------------------------------------|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------------------|
| 9°0 | 9°2 | 9°4 | 9°6 | 9°8 | 10°0 | 10°2 | 10°4 | 10°6 | 10°8 | 11°0 | 11°2 | 11°4 | 11°6 | 11°8 | |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 20 |
| 4 | 5 | 5 | 5 | 5 | 4 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 21 |
| 5 | 5 | 5 | 5 | 5 | 4 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 22 |
| 7 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 4 | .. | .. | .. | .. | 23 |
| 12 | 12 | 11 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 24 |
| 18 | 17 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 10 | 25 |
| 27 | 26 | 25 | 24 | 23 | 23 | 22 | 21 | 20 | 20 | 19 | 19 | 18 | 17 | 17 | 26 |
| 33 | 33 | 32 | 31 | 30 | 30 | 29 | 28 | 27 | 27 | 26 | 26 | 25 | 24 | 24 | 27 |
| 38 | 37 | 36 | 35 | 34 | 34 | 33 | 32 | 31 | 31 | 30 | 30 | 29 | 28 | 28 | 28 |
| 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 33 | 32 | 32 | 31 | 30 | 30 | 29 |
| 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 35 | 34 | 34 | 33 | 32 | 32 | 40 |
| 44 | 43 | 42 | 41 | 40 | 40 | 39 | 38 | 37 | 36 | 36 | 35 | 34 | 33 | 32 | 41 |
| 46 | 45 | 44 | 43 | 42 | 41 | 41 | 40 | 39 | 39 | 38 | 37 | 36 | 35 | 34 | 42 |
| 47 | 46 | 45 | 44 | 43 | 42 | 42 | 41 | 40 | 39 | 39 | 38 | 37 | 36 | 35 | 43 |
| 48 | 47 | 46 | 45 | 44 | 44 | 43 | 42 | 41 | 40 | 40 | 39 | 38 | 37 | 36 | 44 |
| 49 | 48 | 47 | 46 | 45 | 45 | 44 | 43 | 42 | 41 | 41 | 40 | 40 | 39 | 39 | 45 |
| 50 | 49 | 48 | 47 | 46 | 46 | 45 | 44 | 43 | 42 | 42 | 41 | 41 | 40 | 40 | 50 |
| 51 | 50 | 49 | 48 | 47 | 47 | 46 | 45 | 44 | 43 | 44 | 43 | 42 | 41 | 41 | 51 |
| 52 | 51 | 50 | 49 | 48 | 48 | 47 | 46 | 45 | 44 | 45 | 44 | 43 | 42 | 42 | 52 |
| 53 | 52 | 51 | 50 | 49 | 49 | 48 | 47 | 46 | 45 | 46 | 45 | 44 | 43 | 44 | 53 |
| 54 | 53 | 52 | 51 | 50 | 50 | 49 | 48 | 47 | 46 | 46 | 45 | 45 | 44 | 44 | 60 |
| 55 | 54 | 53 | 52 | 51 | 51 | 50 | 49 | 48 | 47 | 47 | 46 | 46 | 45 | 45 | 61 |
| 55 | 55 | 54 | 53 | 52 | 52 | 51 | 50 | 49 | 48 | 48 | 47 | 47 | 46 | 46 | 62 |
| 56 | 55 | 54 | 53 | 52 | 52 | 51 | 51 | 50 | 49 | 49 | 48 | 48 | 47 | 47 | 63 |
| 56 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 50 | 50 | 49 | 48 | 47 | 47 | 64 |
| 57 | 57 | 56 | 55 | 54 | 54 | 53 | 52 | 51 | 50 | 50 | 49 | 49 | 48 | 48 | 65 |
| 58 | 57 | 56 | 55 | 54 | 54 | 53 | 52 | 51 | 51 | 51 | 50 | 50 | 49 | 49 | 66 |
| 59 | 58 | 57 | 56 | 55 | 55 | 54 | 53 | 52 | 52 | 52 | 51 | 51 | 50 | 50 | 67 |
| 59 | 59 | 58 | 57 | 56 | 56 | 55 | 54 | 53 | 53 | 53 | 52 | 52 | 51 | 51 | 68 |
| 60 | 59 | 58 | 57 | 56 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 70 |
| 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 71 |
| 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 72 |
| 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 73 |
| 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 74 |
| 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 75 |
| 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 76 |
| 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 77 |
| 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 78 |
| 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 79 |
| 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 80 |

TABLE OF RELATIVE

| Dry Bulb Reading. | DIFFERENCE BETWEEN THE READINGS OF | | | | | | | | | | | | | | |
|----------------------|------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 12°0 | 12°2 | 12°4 | 12°6 | 12°8 | 12°0 | 12°2 | 12°4 | 12°6 | 12°8 | 14°0 | 14°2 | 14°4 | 14°6 | 14°8 |
| 0 | | | | | | | | | | | | | | | |
| 20 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 22 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 24 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 26 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 28 | 5 | 5 | 5 | 5 | 5 | 4 | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 30 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 5 |
| 32 | 16 | 16 | 15 | 15 | 15 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 11 | 11 | 11 |
| 34 | 23 | 23 | 22 | 21 | 21 | 20 | 20 | 19 | 18 | 18 | 17 | 17 | 16 | 16 | 15 |
| 36 | 27 | 27 | 26 | 25 | 25 | 24 | 24 | 23 | 22 | 22 | 21 | 21 | 20 | 20 | 19 |
| 38 | 29 | 29 | 28 | 27 | 27 | 26 | 26 | 25 | 24 | 24 | 23 | 23 | 22 | 22 | 21 |
| 40 | 31 | 31 | 30 | 29 | 29 | 28 | 28 | 27 | 26 | 26 | 25 | 25 | 24 | 24 | 23 |
| 42 | 32 | 32 | 31 | 30 | 30 | 29 | 29 | 28 | 27 | 27 | 26 | 26 | 25 | 25 | 24 |
| 44 | 34 | 34 | 33 | 32 | 32 | 31 | 31 | 30 | 29 | 29 | 28 | 28 | 27 | 27 | 26 |
| 46 | 35 | 35 | 34 | 33 | 33 | 32 | 32 | 31 | 30 | 30 | 29 | 29 | 28 | 28 | 27 |
| 48 | 36 | 36 | 35 | 34 | 34 | 33 | 33 | 32 | 31 | 31 | 30 | 30 | 29 | 29 | 28 |
| 50 | 38 | 38 | 37 | 36 | 36 | 35 | 35 | 34 | 33 | 33 | 32 | 32 | 31 | 31 | 30 |
| 52 | 39 | 39 | 38 | 37 | 37 | 36 | 36 | 35 | 34 | 34 | 33 | 33 | 32 | 32 | 31 |
| 54 | 40 | 40 | 39 | 38 | 38 | 37 | 37 | 36 | 35 | 35 | 34 | 34 | 33 | 33 | 32 |
| 56 | 41 | 41 | 40 | 39 | 39 | 38 | 38 | 37 | 36 | 36 | 35 | 35 | 34 | 34 | 33 |
| 58 | 43 | 43 | 42 | 41 | 41 | 40 | 40 | 39 | 38 | 38 | 37 | 37 | 36 | 36 | 35 |
| 60 | 45 | 45 | 44 | 43 | 43 | 42 | 42 | 41 | 40 | 40 | 39 | 39 | 38 | 38 | 37 |
| 62 | 47 | 47 | 46 | 45 | 45 | 44 | 44 | 43 | 42 | 42 | 41 | 41 | 40 | 40 | 39 |
| 64 | 48 | 48 | 47 | 46 | 46 | 45 | 45 | 44 | 43 | 43 | 42 | 42 | 41 | 41 | 40 |
| 66 | 49 | 49 | 48 | 47 | 47 | 46 | 46 | 45 | 44 | 44 | 43 | 43 | 42 | 42 | 41 |
| 68 | 50 | 50 | 49 | 48 | 48 | 47 | 47 | 46 | 45 | 45 | 44 | 44 | 43 | 43 | 42 |
| 70 | 51 | 51 | 50 | 49 | 49 | 48 | 48 | 47 | 46 | 46 | 45 | 45 | 44 | 44 | 43 |
| 72 | 52 | 52 | 51 | 50 | 50 | 49 | 49 | 48 | 47 | 47 | 46 | 46 | 45 | 45 | 44 |
| 74 | 53 | 53 | 52 | 51 | 51 | 50 | 50 | 49 | 48 | 48 | 47 | 47 | 46 | 46 | 45 |
| 76 | 54 | 54 | 53 | 52 | 52 | 51 | 51 | 50 | 49 | 49 | 48 | 48 | 47 | 47 | 46 |
| 78 | 55 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 50 | 50 | 49 | 49 | 48 | 48 | 47 |
| 80 | 56 | 56 | 55 | 54 | 54 | 53 | 53 | 52 | 51 | 51 | 50 | 50 | 49 | 49 | 48 |

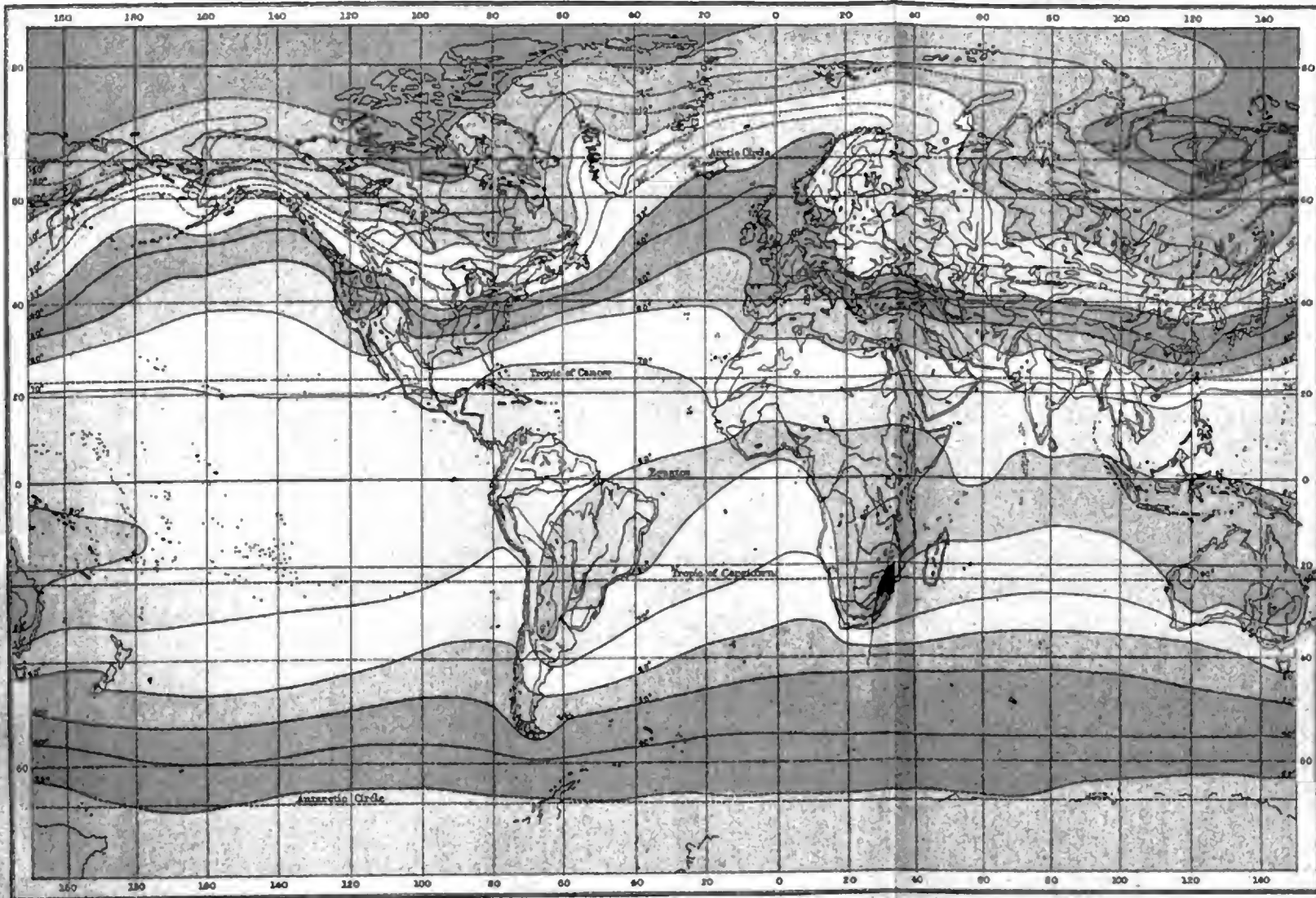
HUMIDITY.—Continued.

| THE DRY AND WET BULB THERMOMETERS. | | | | | | | | | | | | | | | Dry Bulb Reading. |
|------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------------------|
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | |
| 15.0 | 15.2 | 15.4 | 15.6 | 15.8 | 16.0 | 16.2 | 16.4 | 16.6 | 16.8 | 17.0 | 17.2 | 17.4 | 17.6 | 17.8 | 18.0 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 20 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 21 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 22 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 23 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 24 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 25 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 26 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 27 |
| .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 28 |
| 5 | 5 | 5 | 5 | 4 | 4 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 30 |
| 10 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 31 |
| 15 | 15 | 14 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 11 | 10 | 32 |
| 20 | 19 | 19 | 18 | 18 | 17 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 14 | 13 | 33 |
| 21 | 21 | 20 | 20 | 20 | 19 | 19 | 18 | 18 | 17 | 17 | 16 | 16 | 16 | 15 | 34 |
| 22 | 22 | 22 | 22 | 22 | 21 | 21 | 20 | 20 | 19 | 19 | 18 | 18 | 18 | 17 | 35 |
| 23 | 23 | 23 | 23 | 23 | 22 | 22 | 21 | 21 | 20 | 20 | 19 | 19 | 19 | 18 | 36 |
| 24 | 24 | 24 | 24 | 24 | 23 | 23 | 22 | 22 | 21 | 21 | 20 | 20 | 20 | 19 | 37 |
| 25 | 25 | 24 | 24 | 24 | 23 | 23 | 22 | 22 | 21 | 21 | 20 | 20 | 20 | 19 | 38 |
| 26 | 26 | 25 | 25 | 25 | 24 | 24 | 23 | 23 | 22 | 21 | 21 | 21 | 21 | 20 | 39 |
| 27 | 27 | 27 | 26 | 26 | 25 | 24 | 23 | 23 | 22 | 22 | 22 | 21 | 21 | 20 | 40 |
| 28 | 28 | 27 | 26 | 26 | 25 | 24 | 23 | 23 | 22 | 22 | 22 | 21 | 21 | 20 | 41 |
| 29 | 28 | 28 | 27 | 27 | 26 | 26 | 25 | 25 | 24 | 24 | 23 | 22 | 22 | 21 | 42 |
| 30 | 29 | 29 | 28 | 28 | 27 | 27 | 26 | 26 | 25 | 25 | 24 | 24 | 24 | 23 | 43 |
| 31 | 30 | 30 | 29 | 29 | 28 | 28 | 27 | 27 | 26 | 26 | 25 | 25 | 25 | 24 | 44 |
| 32 | 31 | 31 | 30 | 30 | 29 | 29 | 28 | 28 | 27 | 27 | 26 | 26 | 26 | 25 | 45 |
| 33 | 32 | 32 | 31 | 31 | 30 | 30 | 29 | 29 | 28 | 28 | 27 | 27 | 27 | 26 | 46 |
| 34 | 33 | 33 | 32 | 32 | 31 | 31 | 30 | 30 | 29 | 29 | 28 | 28 | 28 | 27 | 47 |
| 35 | 34 | 34 | 33 | 33 | 32 | 32 | 31 | 31 | 30 | 30 | 29 | 29 | 28 | 28 | 48 |
| 36 | 35 | 35 | 34 | 34 | 33 | 33 | 32 | 32 | 31 | 31 | 30 | 30 | 29 | 29 | 49 |
| 37 | 36 | 36 | 35 | 35 | 34 | 34 | 33 | 33 | 32 | 32 | 31 | 31 | 30 | 30 | 50 |
| 38 | 37 | 37 | 36 | 36 | 35 | 35 | 34 | 34 | 33 | 33 | 32 | 32 | 31 | 31 | 51 |
| 39 | 38 | 38 | 37 | 37 | 36 | 36 | 35 | 35 | 34 | 34 | 33 | 33 | 32 | 32 | 52 |
| 40 | 39 | 39 | 38 | 38 | 37 | 37 | 36 | 36 | 35 | 35 | 34 | 34 | 33 | 33 | 53 |
| 41 | 40 | 40 | 39 | 39 | 38 | 38 | 37 | 37 | 36 | 36 | 35 | 35 | 34 | 34 | 54 |
| 42 | 41 | 41 | 40 | 40 | 39 | 39 | 38 | 38 | 37 | 37 | 36 | 36 | 35 | 35 | 55 |
| 43 | 42 | 42 | 41 | 41 | 40 | 40 | 39 | 39 | 38 | 38 | 37 | 37 | 36 | 36 | 56 |
| 44 | 43 | 43 | 42 | 42 | 41 | 41 | 40 | 40 | 39 | 39 | 38 | 38 | 37 | 37 | 57 |
| 45 | 44 | 44 | 43 | 43 | 42 | 42 | 41 | 41 | 40 | 40 | 39 | 39 | 38 | 38 | 58 |
| 46 | 45 | 45 | 44 | 44 | 43 | 43 | 42 | 42 | 41 | 41 | 40 | 40 | 39 | 39 | 59 |
| 47 | 46 | 46 | 45 | 45 | 44 | 44 | 43 | 43 | 42 | 42 | 41 | 41 | 40 | 40 | 60 |
| 48 | 47 | 47 | 46 | 46 | 45 | 45 | 44 | 44 | 43 | 43 | 42 | 42 | 41 | 41 | 61 |
| 49 | 48 | 48 | 47 | 47 | 46 | 46 | 45 | 45 | 44 | 44 | 43 | 43 | 42 | 42 | 62 |
| 50 | 49 | 49 | 48 | 48 | 47 | 47 | 46 | 46 | 45 | 45 | 44 | 44 | 43 | 43 | 63 |
| 51 | 50 | 50 | 49 | 49 | 48 | 48 | 47 | 47 | 46 | 46 | 45 | 45 | 44 | 44 | 64 |
| 52 | 51 | 51 | 50 | 50 | 49 | 49 | 48 | 48 | 47 | 47 | 46 | 46 | 45 | 45 | 65 |
| 53 | 52 | 52 | 51 | 51 | 50 | 50 | 49 | 49 | 48 | 48 | 47 | 47 | 46 | 46 | 66 |
| 54 | 53 | 53 | 52 | 52 | 51 | 51 | 50 | 50 | 49 | 49 | 48 | 48 | 47 | 47 | 67 |
| 55 | 54 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 50 | 50 | 49 | 49 | 48 | 48 | 68 |
| 56 | 55 | 55 | 54 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 50 | 50 | 49 | 49 | 69 |
| 57 | 56 | 56 | 55 | 55 | 54 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 50 | 50 | 70 |
| 58 | 57 | 57 | 56 | 56 | 55 | 55 | 54 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 71 |
| 59 | 58 | 58 | 57 | 57 | 56 | 56 | 55 | 55 | 54 | 54 | 53 | 53 | 52 | 52 | 72 |
| 60 | 59 | 59 | 58 | 58 | 57 | 57 | 56 | 56 | 55 | 55 | 54 | 54 | 53 | 53 | 73 |
| 61 | 60 | 60 | 59 | 59 | 58 | 58 | 57 | 57 | 56 | 56 | 55 | 55 | 54 | 54 | 74 |
| 62 | 61 | 61 | 60 | 60 | 59 | 59 | 58 | 58 | 57 | 57 | 56 | 56 | 55 | 55 | 75 |
| 63 | 62 | 62 | 61 | 61 | 60 | 60 | 59 | 59 | 58 | 58 | 57 | 57 | 56 | 56 | 76 |
| 64 | 63 | 63 | 62 | 62 | 61 | 61 | 60 | 60 | 59 | 59 | 58 | 58 | 57 | 57 | 77 |
| 65 | 64 | 64 | 63 | 63 | 62 | 62 | 61 | 61 | 60 | 60 | 59 | 59 | 58 | 58 | 78 |
| 66 | 65 | 65 | 64 | 64 | 63 | 63 | 62 | 62 | 61 | 61 | 60 | 60 | 59 | 59 | 79 |
| 67 | 66 | 66 | 65 | 65 | 64 | 64 | 63 | 63 | 62 | 62 | 61 | 61 | 60 | 60 | 80 |

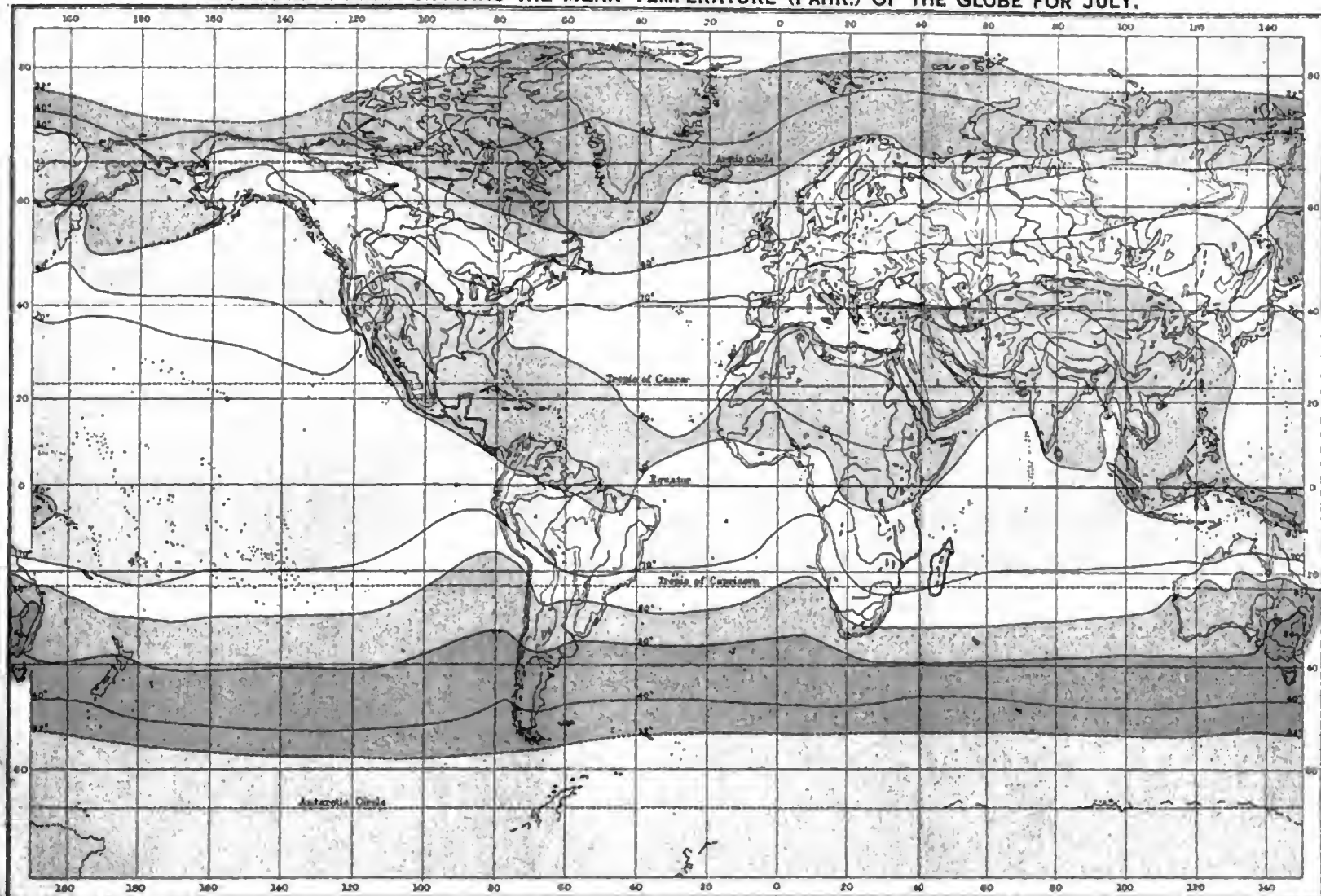
TABLE SHOWING THE PRESSURE OF SATURATED AQUEOUS VAPOUR IN INCHES, OF MERCURY AT LATITUDE 45° FOR EACH DEGREE FAHRENHEIT FROM -80° TO 119°.

| ° | Inch. | ° | Inch. | ° | Inch. | ° | Inch. | ° | Inches. |
|-----|--------|----|--------|----|--------|----|--------|-----|---------|
| -80 | 0.0099 | 0 | 0.0440 | 30 | 0.1665 | 60 | 0.5192 | 90 | 1.4128 |
| -79 | 0.0105 | 1 | 0.0461 | 31 | 0.1738 | 61 | 0.5379 | 91 | 1.4578 |
| -78 | 0.0111 | 2 | 0.0482 | 32 | 0.1815 | 62 | 0.5572 | 92 | 1.5040 |
| -77 | 0.0117 | 3 | 0.0504 | 33 | 0.1888 | 63 | 0.5771 | 93 | 1.5514 |
| -76 | 0.0123 | 4 | 0.0527 | 34 | 0.1964 | 64 | 0.5976 | 94 | 1.6001 |
| -75 | 0.0130 | 5 | 0.0551 | 35 | 0.2043 | 65 | 0.6187 | 95 | 1.6502 |
| -74 | 0.0137 | 6 | 0.0577 | 36 | 0.2125 | 66 | 0.6405 | 96 | 1.7017 |
| -73 | 0.0144 | 7 | 0.0604 | 37 | 0.2210 | 67 | 0.6630 | 97 | 1.7546 |
| -72 | 0.0152 | 8 | 0.0632 | 38 | 0.2297 | 68 | 0.6862 | 98 | 1.8088 |
| -71 | 0.0160 | 9 | 0.0661 | 39 | 0.2388 | 69 | 0.7101 | 99 | 1.8645 |
| -70 | 0.0168 | 10 | 0.0691 | 40 | 0.2482 | 70 | 0.7347 | 100 | 1.922 |
| -69 | 0.0177 | 11 | 0.0723 | 41 | 0.2579 | 71 | 0.7601 | 101 | 1.980 |
| -68 | 0.0186 | 12 | 0.0756 | 42 | 0.2679 | 72 | 0.7862 | 102 | 2.041 |
| -67 | 0.0196 | 13 | 0.0790 | 43 | 0.2783 | 73 | 0.8131 | 103 | 2.103 |
| -66 | 0.0205 | 14 | 0.0825 | 44 | 0.2890 | 74 | 0.8409 | 104 | 2.166 |
| -65 | 0.0217 | 15 | 0.0862 | 45 | 0.3001 | 75 | 0.8695 | 105 | 2.231 |
| -64 | 0.0228 | 16 | 0.0901 | 46 | 0.3116 | 76 | 0.8989 | 106 | 2.298 |
| -63 | 0.0239 | 17 | 0.0942 | 47 | 0.3235 | 77 | 0.9292 | 107 | 2.366 |
| -62 | 0.0251 | 18 | 0.0985 | 48 | 0.3358 | 78 | 0.9604 | 108 | 2.437 |
| -61 | 0.0263 | 19 | 0.1030 | 49 | 0.3485 | 79 | 0.9925 | 109 | 2.509 |
| -60 | 0.0276 | 20 | 0.1076 | 50 | 0.3616 | 80 | 1.0255 | 110 | 2.583 |
| -59 | 0.0289 | 21 | 0.1124 | 51 | 0.3751 | 81 | 1.0595 | 111 | 2.659 |
| -58 | 0.0303 | 22 | 0.1174 | 52 | 0.3891 | 82 | 1.0945 | 112 | 2.736 |
| -57 | 0.0318 | 23 | 0.1226 | 53 | 0.4036 | 83 | 1.1305 | 113 | 2.817 |
| -56 | 0.0333 | 24 | 0.1282 | 54 | 0.4186 | 84 | 1.1675 | 114 | 2.898 |
| -55 | 0.0349 | 25 | 0.1339 | 55 | 0.4341 | 85 | 1.2056 | 115 | 2.982 |
| -54 | 0.0366 | 26 | 0.1399 | 56 | 0.4501 | 86 | 1.2447 | 116 | 3.067 |
| -53 | 0.0383 | 27 | 0.1462 | 57 | 0.4566 | 87 | 1.2850 | 117 | 3.156 |
| -52 | 0.0401 | 28 | 0.1526 | 58 | 0.4836 | 88 | 1.3264 | 118 | 3.246 |
| -51 | 0.0420 | 29 | 0.1594 | 59 | 0.5011 | 89 | 1.3690 | 119 | 3.338 |

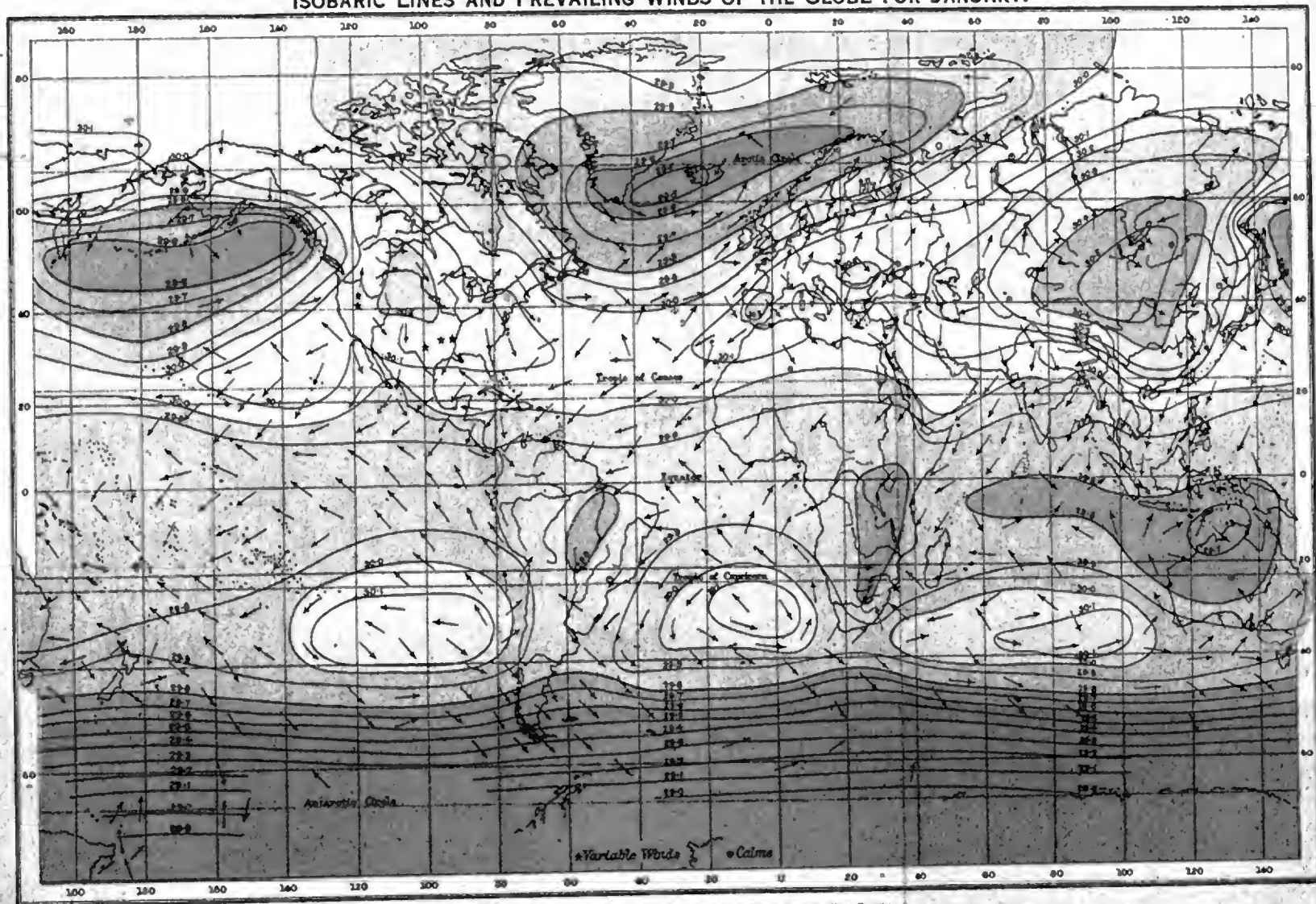
ISOTHERMAL LINES SHOWING THE MEAN TEMPERATURE (FAHR.) OF THE GLOBE FOR JANUARY.



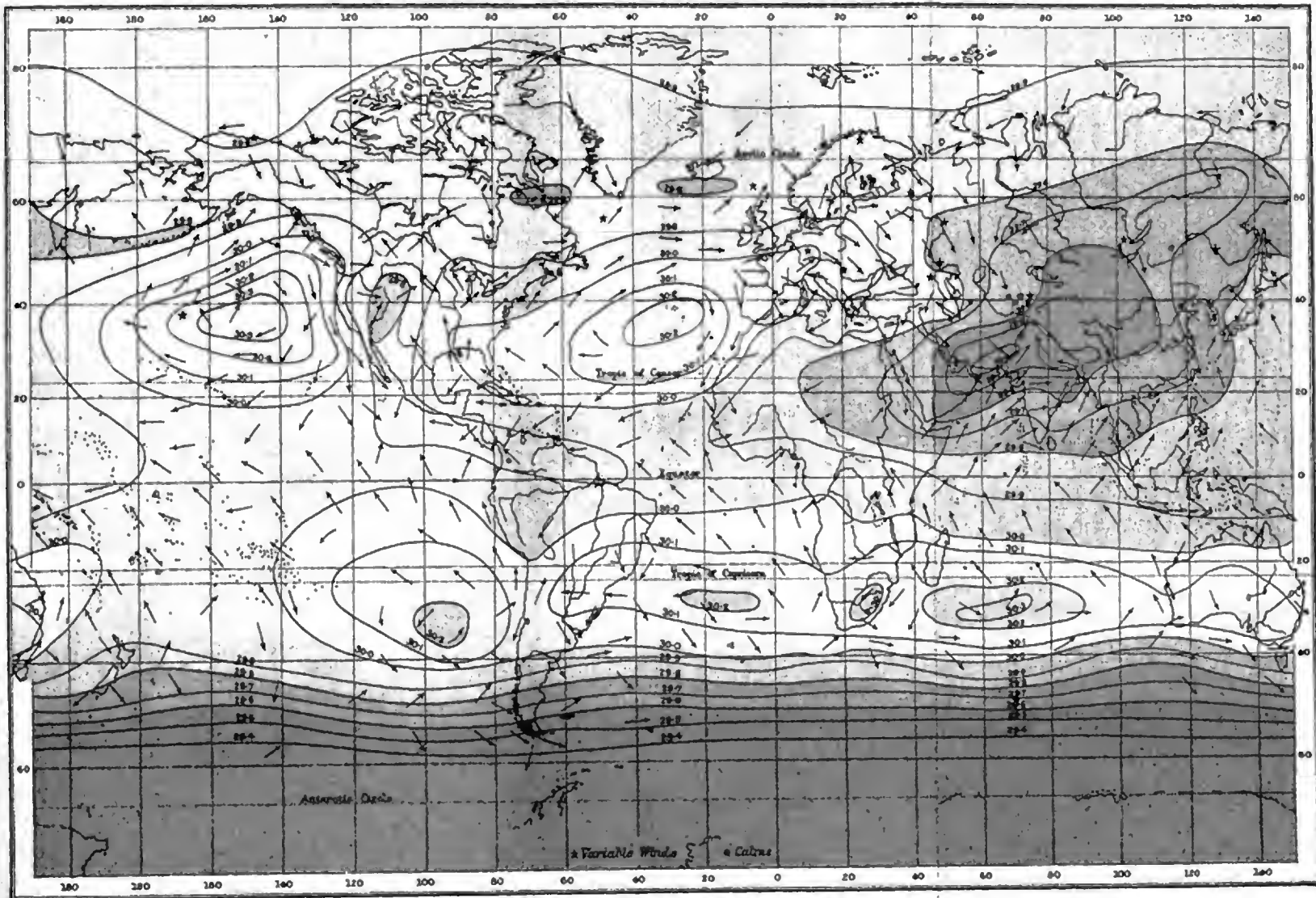
ISOTHERMAL LINES SHOWING THE MEAN TEMPERATURE (FAHR.) OF THE GLOBE FOR JULY.



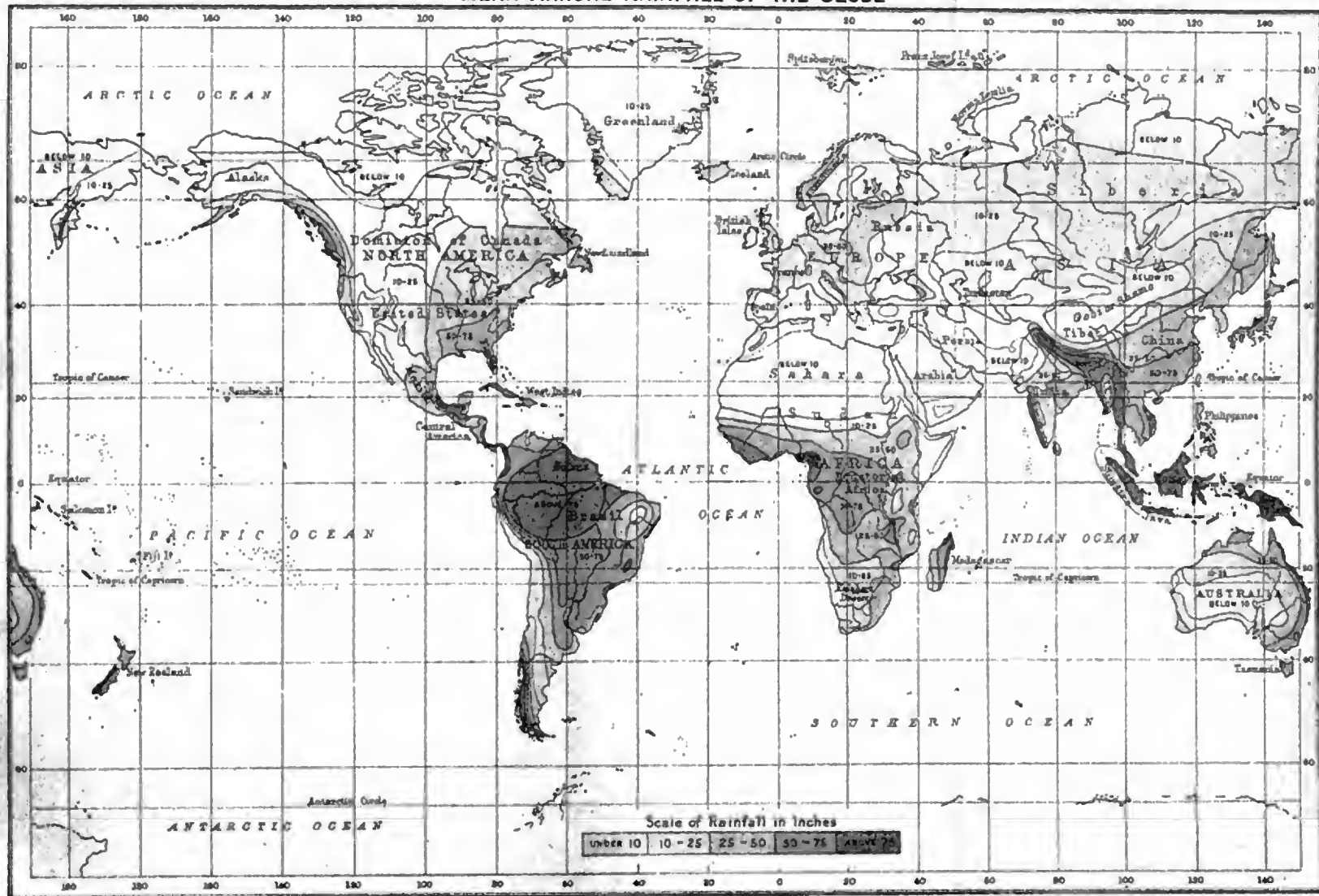
ISOBARIC LINES AND PREVAILING WINDS OF THE GLOBE FOR JANUARY.



ISOBARIC LINES AND PREVAILING WINDS OF THE GLOBE FOR JULY.



MEAN ANNUAL RAINFALL OF THE GLOBE



II.

PHOTOGRAPHY.

By J. THOMSON, formerly Instructor in Photography R.G.S.

Revised by J. McINTOSH,

Secretary of the Royal Photographic Society of Great Britain.

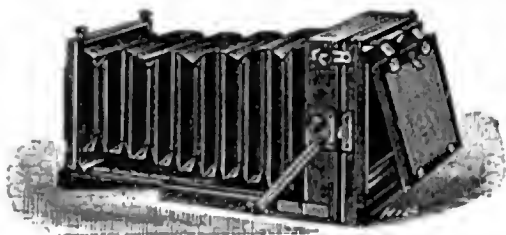
THE photographic camera should form an essential part of the traveller's outfit, as it affords the only trustworthy means of obtaining pictorial records of his journey, and it is also helpful in making the survey of a new region, delineating its contours, its geological and botanical features, and ethnographical types of race. The camera and materials necessary for a journey may be readily obtained, so designed as to minimise space and weight, and in every way so perfectly adapted to the traveller's needs as to ensure successful results in every variety of climate, and render the operation of taking a photograph extremely simple. It is necessary, however, that the traveller should make himself master of the principles involved in the production of a successful photograph, as he will have to depend on his personal effort in exposing and developing the plate, etc. He should also acquire a knowledge of the construction of the camera, to enable him to effect slight repairs when necessary.

In selecting an outfit he must first decide upon the size of plate to be carried, and that need not exceed what is termed "half-plate," $6\frac{1}{2} \times 4\frac{1}{2}$ inches; which is large enough for the best work. The smallest effective size for scientific work may be "quarter-plate," $4\frac{1}{2} \times 8\frac{1}{2}$ inches; in use in many hand-cameras. Negatives on this scale, if perfect, may be enlarged for book illustration, or printed as lantern slides. The two sizes given form a very complete outfit when extra weight may be conveniently carried.

Selecting a Camera.—The cameras should have bellows bodies of Russian leather which folds into small space, the woodwork must be well seasoned to prevent warping, or cracking under a hot sun. The

framework should be metal-bound at the corners, and the camera fitted with a rising front and swing back, although the swing back is not indispensable. A reversible back (now universal) is of advantage, as it enables the operator to take vertical or horizontal views without turning the camera on its side. If the camera is fitted with a swing-front, the swing-back becomes unnecessary. The swing-front is in all ways preferable to the swing-back.

The Hand-camera.—Hand-cameras are designed to carry a dozen or more plates or films in flat sheets or in spools, so arranged inside the camera as to be changed after each exposure by simply turning a milled head, or moving a lever. Rolled films are not recommended for

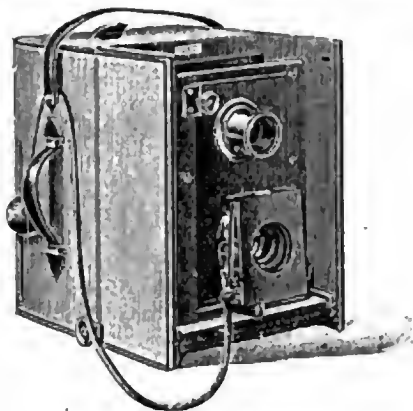


BELLOWS CAMERA.

travellers' use in hot and humid climates. Sir Martin Conway says: "A traveller who carries glass plates and flat films will probably bring home a larger percentage of good negatives from a long mountain journey than one who relies upon spools of films." There can be no question about the force and accuracy of this statement. My own experience goes to prove that a camera arranged for glass plates and flat films is best.

The twin-lens hand-camera made by Ross, of New Bond Street, London, offers several advantages in its design. It is fitted with a focal-plane shutter which is in every way simple and effective. The twin lenses are of equal focal length, enabling the object to be photographed to be seen on the same scale as it will appear in the finished negative, so that just what is required may be embraced in the field. It consists

of a stout body of thoroughly seasoned hardwood, not easily damaged by rough usage. The principal fittings required for adjusting the instrument are inside, protected by the outer case. The exception to this arrangement is the milled head by means of which the two lenses are focussed at the same time. The lenses are of uniform focal length, so that the image transmitted by the "finder" is a counterpart of the image which falls upon the sensitive plate. The advantage of this is that the object to be taken is seen on the finder-screen to scale exactly as it will appear in the finished photograph. By this means the operator



TWIN-LENS CAMERA (OPEN).

has it in his power to place the object in the required position on the screen at the moment of exposure. This is of signal importance if the object is moving about. It must also be noted that this form of camera may be used when the operator is facing at right angles to the object to be photographed. I have frequently found that natives of foreign countries resent the liberty taken of pointing a camera at them, and fly as if they expected to be shot. The slides are each made to hold two plates, or flat films. They are strong, serviceable, and easily managed, while the body of the camera is so arranged as to carry a roll holder.

The camera can also be adapted to stereoscopic work, and fitted for the use of glass plates, flat films, or rolled films.

A light tripod stand should be taken for supporting the camera when longer exposures are required than can be given in the hand. A very satisfactory compromise has been adopted by Sir W. Abney between using the camera in the hand and on a tripod. He rests the camera on top of a walking-stick when making hand exposures, with the result that he overcomes all tremor caused by pulsation, and so secures photographs full of sharp detail.

The same object is obtained by the reflex type of camera in which the image formed by the lens is thrown upon a silver-faced mirror and reflected upward to the focussing screen. Focussing can be carried out, and a moving object followed till the moment when the exposure is made. The reflex type of camera is a trifle less bulky than the twin-lens, and, of course, only one high class and expensive lens is required.

A Focussing-cloth.—This is used for keeping out the light while focussing, being thrown over the camera and the head of the operator. It is generally made of black velvet, but waterproof sheeting is much better. It should have rings sewn on to one edge, or some arrangement by which it may be attached to the camera so as not to be blown away.

Camera-stand.—There are many varieties of tripod stands, with legs either folding or sliding into a small compass. For mountainous country it is of great advantage to have a stand with telescopic legs, as they can be readily altered in length so as to stand firmly on slopes or rocky ground. The smallest size, weighing about 3 lbs., and measuring 33 in. long when closed, and standing about 4 ft. 6 in. high, is steady enough to support a $6\frac{1}{2} \times 4\frac{1}{2}$ camera without perceptible vibration in a moderate wind.

A Small Circular Cup Level, let into the wood of the camera, for levelling the camera on the tripod, is a useful addition.

Lenses.—There are many lenses in the market, and as it is impossible to do good work with an inferior lens, it is necessary to exercise great care in selecting this part of a photographic outfit. Lenses known as rectilinear or symmetrical are useful to a scientific explorer, and are well fitted for producing pictorial effect in his work.

Ordinary portrait lenses are designed specially for rapid work, and this

is attained at the cost of qualities in a lens most useful to an explorer. The so-called portrait combination should therefore be avoided.

Rectilinear and symmetrical lenses give true images of objects to be photographed free from distortion, so that straight lines are reproduced as straight lines. In this way they are invaluable where accurate measurements have to be taken from photographs produced by them.

Ross's homocentric lens is one of the most useful lenses. It has a flat field, is free from what is called "coma" and astigmatism, and is so perfectly corrected as to fit it for interior and exterior work alike. It is also a rapid hand-camera lens. The homocentric are made in series to suit all cameras. Other lenses may also be noted, viz.: c. Dallmeyer's rapid rectilinear, including about 37°. d. Zeiss's anastigmat, made by



HOMOCENTRIC LENS.

Ross, consists of a double front lens and a triple back lens. It is intended for portraits, groups, copying, and general outdoor work. The combinations being brought closely together, gives them great illuminating power. They have an angular aperture of from 85° to 90°, and can therefore be used as wide-angle lenses when desired. In consequence of the peculiar system of correction for oblique pencils adopted in these lenses, they behave somewhat differently from the usual types with regard to the mode of compensating the effect of the resulting aberrations between centre and margin of the field. This is, of course, only possible in the case of perfectly plane objects. In all other cases—landscape, instantaneous work, or interiors—the centre should be focussed rather than objects at a distance or foreground.

Focus.—It will be sufficient to say that focal length means the distance between the diaphragm of a lens, and the ground-glass screen when the image of a distant object is seen most distinctly on the screen.

Exposure Tables.—Exposure tables are based on the focal length of a lens, in relation to the diameter of the diaphragm of a lens. Thus, if the focus is eight inches and diameter of diaphragm one inch, the relationship will be expressed by $\frac{f}{8}$ or by the uniform standard number 4, and so on, as in table. The diaphragms are so arranged for size of opening that each succeeding number requires double the exposure necessary with the one preceding it. $\frac{f}{11.8}$, for example, requires double the exposure wanted with $\frac{f}{8}$.

| | | | | | | | |
|---------------------|---------------|------------------|----------------|------------------|----------------|------------------|----------------|
| U. S. Nos. | 4 | 8 | 16 | 32 | 64 | 128 | 256 |
| Ratio of Stops..... | $\frac{f}{8}$ | $\frac{f}{11.3}$ | $\frac{f}{16}$ | $\frac{f}{22.6}$ | $\frac{f}{32}$ | $\frac{f}{45.2}$ | $\frac{f}{64}$ |

Such tables are useful guides to the relative duration of exposure with diaphragms of different sizes applied to the same lens. They afford no clue, however, to time of exposure to be given with any particular lens or diaphragm. This can be best ascertained by experience, as duration of exposure of a plate or film in the camera depends on the sensitiveness of the plate, the time of day, the sun, the state of the atmosphere, the nearness or distance of the object to be photographed, etc. To take an extreme case of the difference of time required to impress the plate with the image of an exterior view and that of an interior, a landscape open and well lighted may be taken in the fraction of a second, while a dimly-lighted interior with the same lens would require an hour, both being taken with plates coated with the same emulsion. The duration of exposure may be approximately estimated by using an exposure meter such as may be obtained from any photographic dealer's. It is useful to keep an exposure record; a handy book for this purpose is published by Messrs. Burroughs & Welcome. In this book rules are set down for exposure during different months of the year and for different latitudes.

These are apt to prove misleading to the amateur. The simplest method of measuring the actinic power of light in any latitude, and at any moment, is by actinometer, giving plate-speeds, focus of lens, etc. Watkins "Bee Meters" are excellent for this purpose.

Sensitive Plates or Films.—Gelatine plates are now made commercially by a large number of firms and of great excellence; they keep indefinitely before exposure, and for a long time afterwards and before development and under some circumstances (as for instantaneous pictures, portraits, and dimly-lighted interiors) will give results which could hardly be obtained at all on collodion plates. Gelatine plates are made of various degrees of sensitiveness; the slowest are best for ordinary landscape work. They are generally supplied in parcels of a dozen each, packed face to face with strips of folded paper between opposite edges. The card boxes in which they are usually packed are an insufficient protection against injury and damp. In all cases it is advisable, and for sea voyages and damp climates essential, to have each package of a dozen plates soldered down in a tin case, and afterwards packed in a light wooden box with tow or cotton wool, and the box screwed (not nailed) down. In packing them up again after exposure or after development, a good plan (due to Sir W. Abney) is to provide oneself with a number of cardboard frames exactly the size of the plates, made of strips of card about $\frac{1}{4}$ in. wide, one of which is inserted between every two plates film to film. The packages thus made up should be soldered down again, and treated with at least as much care as the original plates in packing. Should there be no available means of resoldering the boxes, it will be better to have tin boxes with the lid turned well down, the joinings to be closed by strong well-gummed paper or medical rubber strapping. It will also be well to be provided with a supply of waterproof paper, or cloth, as an additional precaution in packing and in case of emergencies.

Sensitive films in rolls or spools are made by the Kodak and other companies, and may be used successfully in their proper roll-holders when they can be kept perfectly dry in temperate climates. Flat films made by Kodak, Ltd., and others have many advantages for travellers. The celluloid of which they are made is very much lighter than glass, and in exposure and development may be treated in the same way as a glass plate. When plates can be carried, the extra weight is compensated for by greater certainty of success, and general excellence in the photographs.

How to Keep Plates and Films Dry.—When the traveller has a long journey before him, and the prospect of storing his plates and films for months both before and after exposure, it is of the greatest importance that precautions should be taken against the inroads of damp. This applies with full force when the country to be explored has a hot, humid climate. Plates and films that have absorbed moisture, causing decomposition in the sensitive gelatine coating, are frequently brought back to this country to be developed, and are the most fruitful cause of failure. The remedy is simple, but can only be applied when packing and repacking the plates. Some guarantee should be sought from makers of plates and films that they are packed perfectly dry, and that the packing used is also dry. Assuming that work has to be done in a damp climate and that the plates have been exposed in the camera and require to be repacked, they should be dried in a box containing a small quantity of chloride of calcium. The box used for drying may be also designed to carry the camera and outfit. It should have a lid with a rim of rubber padding, so that by putting the lid on and a weight on it, the box would be fairly air-tight. Stack the exposed plates, or films, in the bottom of box, so separated as to permit the passage of air between. Place a cup or saucer on the bottom of box containing chloride of calcium. (The chloride should be first dried on a piece of iron over a fire.) Put on the lid and allow the plates to remain for an hour or more. Dry all the packing materials, remove the plates from the box and repack. The chloride will have absorbed the moisture in the plates, and rendered them quite dry and safe for preserving for an indefinite length of time.

Apparatus and chemicals for development.—The development of the plates or films after exposure in the camera requires practice and experience in order to secure the best results. Instructions for development are sent out with all commercial plates or papers, but many failures would certainly result from attempting to work by these without some preliminary practice at home. As plates, &c., will keep after exposure (if well protected from damp) for 18 months, or longer if properly packed, it is not, of course, necessary to develop them *en route*, although if the traveller possess sufficient skill, and if ample water-supply and other facilities can be secured, it will be advantageous for many reasons to do so. On a long journey, when the temperature is not too high, use of convenient resting-places may be made to develop from time to time a few plates selected from the whole, both as tests for exposure and as

proof that all the apparatus is in order. The following list comprises all that is absolutely required for developing 8 or 10 dozen gelatine plates:— Three papier-mâché dishes, two 3-ounce glass measures, three 8-ounce bottles, containing strong solutions of pyrogallic acid preserved with potassium meta-bisulphite, potassium bromide, and sodium carbonate respectively, 1 lb. hyposulphite of soda, and $\frac{1}{2}$ lb. alum, both in crystals, 4 or 5 feet of indiarubber tubing and a spring clip, to make a syphon for a water supply from a jug or can, a basin or tub to serve as a sink, a folding rack for draining the plates.

There are several convenient new developing agents in the market: Hydro-Kinone, Eikonogen, Glycin, Metol, Rodinal, and Amidel. Some of these were made and named in Germany, they are no longer procurable under their German names. English manufacturers are however making substitutes quite as good under new names, and these can be obtained from the dealers. Many of them can be obtained in compressed form.

The traveller is recommended for advanced study of photography, such works as *Instructions in Photography* by Sir Wm. Abney, *The Science and Art of Photography* by Chapman Jones, and *The Manual of Photographic Exposure and Development* by Alfred Watkins, which may be had from any photographic dealer's.

The aim of the traveller-photographer should be the production of good *negatives*. It often requires years of study on the part of professional operators (with advantages impossible to the traveller) before thoroughly good negatives are habitually produced; and it must not be supposed that a person taking up photography for the first time, in a few hurried moments before departure on a journey, will attain other than very unsatisfactory results.

The operations necessary for taking a picture are briefly as follows:— Having selected the position from which the view is to be taken (for valuable hints as to the *artistic* production of pictures see Robinson's '*Pictorial Effect in Photography*'), the tripod stand is first set up, and the head approximately levelled by means of the pocket level, altering the position or length of the legs as may be necessary. The camera is next screwed on to the stand, and the lens selected which on trial is found to include the required amount of subject. For groups or portraits a long focus lens with wide aperture, such as Dallmeyer's "*Rapid*

rectilinear," 11 in. focus, should be used. The next operation is to focus the picture accurately on the ground-glass screen of the camera. The focussing-cloth is thrown over the head and the camera, so as to exclude the light as much as possible, and while looking at the inverted image on the ground glass, the milled head of the rack adjustment is turned till the image appears as sharp as possible. The camera is now turned about on its vertical axis till it exactly includes the view intended to be taken, and the screw is tightened. It may be necessary to raise or lower the front of the camera carrying the lens in order to include objects at a high or low elevation; if the vertical range of this sliding front is insufficient, the camera must be tilted; but, if this is done, care must be taken to set the focussing-screen vertical again by means of the swing back, and to readjust the focus. The full aperture of the lens should always be used for focussing, and if the image is not sharp all over the plate it will be necessary to insert a diaphragm in the lens, using the largest that will effect the required object. Having then put the cap on the lens, the hinged frame carrying the focussing-glass is turned over, and one of the slides carrying the sensitive plates is inserted in its place. The slides should be exposed as little as possible to the light, especially avoiding direct sunlight; however carefully constructed, it is difficult to make them absolutely light-tight. The shutter of the slide is then withdrawn, and the exposure made by removing the cap from the lens for time exposure, and by a spring shutter for instantaneous work. The time of exposure must be estimated according to circumstances, and it requires considerable experience to judge of it accurately. A record should be kept in a note-book of every plate exposed, giving the number, date, time, exposure, subject, &c. If the plates cannot be developed the same evening, and the slides are wanted for fresh plates, they must be packed up again, and should be numbered. This is best done by marking the number on the back with a bit of dry soap, or in the film with a lead pencil. The image on the plate after exposure is latent and invisible, and has to be developed. This is effected by pouring on the plate, laid in one of the flat dishes, a dilute solution containing pyrogalllic acid, soda, and potassium bromide. The excellence of the result largely depends on the due proportion between these constituents, and here more experience is perhaps necessary than in any other part of the process. The image having been fully developed, the plate is well washed, and then immersed in a solu-

tion of alum, which hardens the film. After another thorough washing it is "fixed" by immersion in a solution of sodium hyposulphite, which dissolves out the unchanged bromide of silver, and, being once more well washed, it is finished, and must be set up in the rack to dry spontaneously. On no account must heat be applied, not even the warmth of sunlight, or the wet film will melt. When dry it must be varnished to protect the film. The printing operations are best deferred till the return home, as they would involve the carriage of a large amount of extra apparatus. It is generally best to get the printing done by a professional printer; but if the traveller prefers to print from his own negatives he will find full instructions in each packet of paper which he buys.

Colour sensitive plates are now much used and, when a yellow glass filter is placed immediately in front of, or behind, the lens, will give in the print the same variations in depth of tint which the eye sees in the landscape, or other object. The nearest to perfection among these plates are those known as Panchromatic, but they must be developed in total darkness. The subject is a large one and should be studied in the pamphlets on 'orthochromation' published by Kodak (Wratten Division), and Ilford, Ltd.

As regards the expense of a photographic outfit, at the present time the manufacturing trade is still very unsettled, some goods cannot be supplied, and all have been greatly increased in price. Quarter plates which used to be sold at a shilling per dozen are now about 8s. 6d. Application should be made to the dealers for current prices.

The camera, slides and lenses may be arranged to pack into a solid leather case, conveniently in the form of a knapsack, measuring about 16 in. wide, 12 in. high, and 5 in. deep. This can easily be carried on the back of one man, and is of a more convenient shape than the cases generally sold for the purpose.

The plates and other apparatus, with the exception of the knapsack and its contents, and the tripod stand, are best packed for travelling in a strong basket, which is much better than a box, being more elastic and lighter. It will weigh, when packed with the apparatus, and a gross of $7\frac{1}{2} \times 5$ plates, about 60 lbs.

Photography in Natural Colours.

It is now possible for the traveller to bring home records of what he has seen in natural colours. There are two or three known methods by

which this may be done, but few are available for the work of exploration. The picture obtained by the method patented by Mr. Ives and named Krönsköp Photography is produced by three monochrome images. These have however been taken through three tinted glasses in a camera of a special kind. The images may be thrown upon a screen by means of a special lantern; the light passes through tinted glasses of colours complementary to those employed in making the negatives with the result that the picture on the screen exhibits all the varied hues of nature. The devices however are exceedingly expensive and can be satisfactorily employed only by those who thoroughly understand the apparatus and the problems which have to be solved.

Simpler processes are the Autochromic and The Paget Colour Plate process. In the Autochromic process the manufacturers coat a sheet of glass with minute specks of three colours, blue, violet green and orange, irregularly spread, and lay a coat of panchromatic emulsion on top. The photographer exposes through the glass, thus obtaining a negative. The developed silver, the negative image, is dissolved away and the silver bromide remaining is developed giving a positive image in natural colours.

In the Paget process the glass is coated with points of colour laid in a regular pattern. This is called the screen plate and is placed in the dark slide face to face with a colour-sensitive plate, and the expression is made through the screen plate. From the negative so obtained a monochrome positive plate is made, and this is bound up in contact with one of the screen plates. Some little experience is necessary to obtain correct register.

Each process has its difficulties. Most photographers consider that the Autochrome plate gives the nearest approach to natural colours, but the slides are very dense and require an intense light to show them well. The Paget plate is much more transparent and possesses the advantage that any number of positives may be made from the negative, whereas the Autochrome plate having been converted into a positive cannot be multiplied, resembling in that particular the earliest form of photography, the Daguerrotypes.

None of these colour processes are suitable for photographing objects in motion. The exposures may be reckoned as from fifteen to twenty times as long as with an ordinary slow plate.

III.

GEOLOGY.

By THE LATE W. T. BLANFORD, F.R.S.

Revised by PROF. E. J. GARWOOD, F.R.S.

A TRAVELLER who has not devoted some time to studying geology in the field must not be surprised or disappointed if the rocks of any country which he may happen to traverse appear to him a hopeless puzzle. If he desires to investigate the geological structure of an unknown region, he should previously devote some time to mastering, with the aid of a good geological map and description, the details of some well-known tract.

Under the term "Geological Observations," two very distinct types of inquiry are commonly confounded. The first of these, to which the name of Geological Investigation ought properly to be restricted, consists in an examination of the rocks of a country as a whole, so as to enable a geological map, or, at all events, geological sections, to be constructed. This demands a knowledge of rocks (petrology), some acquaintance with the details of geological surveying, and, usually, with the elements of palæontology—a science that, in its turn, requires a preliminary study of biology, and especially of zoology. Despite all these hard terms, any intending traveller who has a taste for geology—if he has none he had better not waste time upon the subject—will find that a few months' study in any good museum, a course of geological lectures, and, above all, a few days in the field with a good geologist, will start him very fairly equipped with the great requisite to all successful scientific investigation, a knowledge of how to observe, and what to observe.

The term "Geological Observations" is, however, often, but incorrectly, used in a second sense, which implies a restriction of the observations to the useful minerals found in any country, or to what is termed economic geology. Here also a preliminary knowledge of the elements of geological

science will be found very useful, and will frequently enable the traveller to form much more trustworthy conclusions as to the nature and value of mineral deposits than he could without such a guide. But the essential point is to recognise a valuable mineral when seen, and for this some knowledge of mineralogy is requisite.

Outfit.—The essential articles of a geologist's outfit are neither numerous nor cumbersome. A very large proportion of the known geology of the world has been made out with no more elaborate appliances than a hammer, a pocket compass with a small index to serve as a clinometer, a pocket-lens, a note-book and a pencil. No scientific observer has to depend more on his own knowledge and faculty for observation, and less on instrumental appliances, than a geologist.

The best hammer for general purposes should weigh from 12 to 24 oz. and should have a square flat end, and a straight cutting end—the latter should be horizontal, and the inner face of the hammer a continuous plane surface. The ends should be of steel, not too highly tempered. The hole for the handle should be as large as possible (with a small hole the handles are so weak as to be liable to break), and the handle should be secured in the hole by a wooden wedge, and an iron one driven into and across the wooden one. It is advisable to take a few spare ash handles and iron wedges. Cut a foot-measure in notches on the handle—this is very useful for measuring thickness of beds, &c. It is as well to have more than one hammer in case of loss, and if fossil-collecting is anticipated, at least one heavy hammer, with one end fashioned to serve as a pick, three or four cold chisels of various sizes, and a short crow-bar will be found useful. In London, hammers, chisels, &c., may be procured of Messrs. Buck, 242, Tottenham Court Road.

A very good pocket compass, the shape and size of a watch, with a clinometer arm, is made by Troughton and Simms, 188, Fleet Street. The use of the clinometer is for measuring the angle of dip in rocks. If more accuracy of measurement is required than is afforded by looking at a bed, a section, or a hill-side, and holding the straight-edge attached to the compass parallel to the dip, and if a surface can be found that affords the exact inclination, it is usually practicable, by means of a note-book laid on the rock surface, or, better still, a folding two-foot rule with a slot for sliding in the compass-clinometer, to obtain a plane

sufficiently close to that at which the beds dip to enable the angle to be determined with a very short straight-edge. As a rule, except with very low angles of dip, the variation in the inclination of the rocks themselves exceeds the limits of error of the instrument. A little care, however, is necessary in taking dips; for the apparent dip seen in a section, such as is often exposed in a cliff, may differ widely from the true dip, which will only be shown *if the section runs at right angles to the strike of the beds*. Dips seen on the sides of hills at a distance are but rarely correct for the same reason.

A prismatic compass and an aneroid are frequently of great service: the former to determine the position on the map, if one exists, and to aid in making a rough map, if there is none; and the latter to estimate roughly the heights on the road travelled, especially in mountainous countries, and also to measure the thickness of horizontal beds. Both form a part of the outfit of most modern travellers. A good aneroid gives sufficiently accurate determinations of height for a rough but adequate geological section across any country, if the distances are known. The Watkin mountain aneroid of Hicks and Co., Hatton Garden, is the most accurate for considerable heights.

Collections.—Geological specimens require little more than paper and boxes, or biscuit tins, for packing. Occasionally fossils or minerals are fragile, and need tow or grass to protect them from injury; but there is no risk from the animal and vegetable enemies of zoological or botanical collections. The only important point to be borne in mind is that *every specimen should be labelled on the spot*, or, at all events, in the course of the day on which it is collected. Strong paper is best for labels, and these should not be put up in contact with the rock-fragments themselves, or they will be worn by sharp edges and become illegible, if not rubbed to fragments. Always wrap each specimen in paper, or some substitute, then add the label, and then an outer covering. The label.*

* Travellers in tropical countries will do wisely to poison all their labels before using them, to preserve them from attacks of insects and mites. Washing with a very weak solution of corrosive sublimate is an efficient plan. A large number of labels, with the collector's name printed on them, may be taken, and if made of strong thin paper they will not occupy much space. Bank-note paper is well adapted for the purpose. Any writing should be, if possible, in ink; if not, a very hard black pencil should be used. Some tie labels should be added, as paper coverings soon run short.

if nothing else is written, should always record the locality distinctly written.

A collection of rock specimens may show what kinds of rock occur in a country, but the information afforded is very meagre, and, in general, of very small value. Such collections, indeed, unless made by a geologist, and accompanied by notes, are scarcely worth the carriage. If such specimens are taken, care should be used to select them from the rocks in place, *not from loose blocks* that may have been transported from a distance. In certain cases, however, where the traveller does not intend to penetrate beyond the low ground, pebbles brought down by streams give some indication of the strata which occur higher in the drainage basin, and the information may be useful to future explorers, but they should always be labelled as such. No fragments of spar or crystals should be collected merely because they are pretty.

In taking specimens of useful minerals, such as coal or metallic ores, the traveller should always endeavour to procure them himself from the place of occurrence, and if such are brought to him by natives, he should, if practicable, visit the locality whence the samples were procured. The value of all useful minerals depends both on quality and quantity; the former can to some extent be ascertained from a sample, but the amount available can only be estimated after a visit to the locality. Most metallic ores occur in veins or lodes. These were originally cracks in the rock, and have been irregularly filled with minerals, different from those in the neighbourhood. It is, however, very difficult, and often impossible, to estimate from surface examination whether the quantity of ore occurring in veins is likely to prove large; some idea may possibly be obtained if underground workings exist. Many of the ores of iron and manganese, some of those of other metals, and all coal and salt occur in beds, and here it is important to see what is the thickness, and to ascertain whether the mineral is equally pure throughout. Iron ores occur in most countries, and unless very pure and within easy reach of water-carriage, are not likely to be worth transport. The value of salt also depends on facilities for carriage. Coal, however, may be of value anywhere; but it is improbable that seams of less thickness than four or five feet can be of much use, except in countries where there is a skilled mining population and a considerable demand for the mineral. It does not follow, because much thinner seams are sufficiently valuable to be worked in Western Europe, that they would

pay for extraction in a country where the mechanical arts are less advanced. Still the occurrence of thin seams is worthy of record, as thicker deposits may exist in the neighbourhood. It must not be inferred, however, that a seam of small thickness at the surface will become thicker below. The reverse is equally probable.

A blow-pipe is extremely useful for ascertaining the nature of ores, and for determining minerals generally, and a small blow-pipe case might be added to a traveller's kit, if he thinks it probable that he may meet with minerals in any quantity. But in general they are not to be found in such profusion as to render it difficult to carry away specimens sufficient for determination at leisure. A blow-pipe, too, is of no use to any one unacquainted with the method of employing it, though this is easy to acquire.*

To form a rough idea of the value of iron ore, see whether it is heavy; to form some notion of the quality of coal, pile up a heap and set fire to it. If it does not burn freely, the prospects of the coal being useful are small. It may be anthracitic, and very valuable with proper appliances; but anthracite is not of the same general utility as bituminous coal. Good coal should burn freely, with more or less flame, and should leave but little ash, and it is preferable that the ash should be white, not red, as the latter colour is often due to the presence of pyrites, a deleterious ingredient.

Gold and gems have, as is well known, been procured in considerable quantities from the sands of rivers and alluvial deposits. The deposits known to the natives of any country are often of small value, and the rude methods of washing prevalent in so many lands suffice to afford a fair idea of the wealth or poverty of the sand washed. Gold and, wherever it is found, platinum occur in grains and nuggets, easily recognised by their colour and their being malleable; but gems, such as diamond, ruby, sapphire, are not so easy to tell from less valuable

* There are plenty of good works on the use of the blow-pipe. The best are by Plattner and Scheerer, of both of which English translations have been published. Of Von Kobell's tables for the determination of minerals, several translations have appeared. Brush and Penfield 1906 edition is a practical work. A very portable outfit may be obtained from J. T. Letcher, Truro, Cornwall.

minerals. They may be recognised by their crystalline form and hardness. A diamond is usually found in some modification of an octahedron, and the crystalline facets are often curved; rubies and sapphires are really differently coloured varieties of corundum or emery, and occur, when crystalline, in six-sided pyramids or some modification. A diamond is the hardest of known substances; nothing will scratch it, and it will scratch all other minerals. Sapphire will scratch everything except diamond. Topaz will scratch quartz.

In collecting fossils, it is useless to take many specimens of one kind unless carriage is exceptionally plentiful. Two or three good examples of each kind are usually sufficient, but as many kinds as possible should be collected. Great care is necessary that all specimens from one bed be kept distinct from those from another stratum, even if the bed be thin and the fossils in the two beds chiefly the same species. If there is a series of beds, one above the other, all containing fossils, measure the thickness roughly, draw a sketch-section in your note-book, apply a letter or a number to each bed in succession on the sketch, and label the fossils from that bed with the same number or letter.

Remains of Vertebrata, especially of mammals, birds and reptiles, are of great interest; but it is useless to collect fragments of bones without terminations. Skulls are much more important than other bones, and even single teeth are well worth collecting. After skulls, vertebrae are the most useful parts of the skeleton, then limb bones. If complete skeletons are found, they are usually well worth some trouble in transporting. If fossil bones are found abundantly in any locality, and the traveller has no sufficient means of transport, he will do well to carry away a few skulls, or even teeth, and carefully note the locality for the benefit of future geologists and explorers. The soil of limestone caverns, and especially the more or less consolidated loam, rubble, clay, or sand beneath the flooring of stalagmite, if it can be examined, should always be searched for bones, and also for indications of man or his works.

The foregoing remarks are intended for all travellers, especially for those who have paid little or no attention to geology. It would be far beyond the object of the present notes to attempt to give instruction in the methods of geological observation; all who wish to know more fully what questions are especially worthy of attention, should consult the article on Geology by the late Dr. Charles Darwin and Professor J. Phillips.

in the 'Admiralty Manual of Scientific Enquiry.' But a few hints may be usefully added here for those who have already some knowledge of geology, who do not require to have such terms as dip, strike, fault, or denudation explained to them, and who are sufficiently conversant with geological phenomena to be able to distinguish sedimentary from volcanic, and metamorphic from unaltered rocks, and to recognise granite, gneiss, schist, basalt, trachyte, slate, limestone, sandstone, shale, &c., in the field. Assuming then that a traveller with some knowledge of field geology is making a journey through a tract of the earth's surface, the geology of which is unknown, what will be the best method of procedure and the principal points to which he should direct his attention?

On the whole, the most useful record of a journey, whether intended for publication or merely as a memorandum, is a sketch geological map of the route followed, with the dips and strikes of the rocks and approximate boundaries to the formations, supplemented by notes and sketch-sections. Where, as is commonly the case in mountain-chains, and frequently in less elevated portions of the country, the rocks are much disturbed, and especially if the number of systems exposed is large and the changes frequent, no traveller can expect to do more than gain a very rough and general idea of the succession of beds in detail, and of the structure; but by making excursions in various directions, whenever a halt is practicable, by searching for fossils as a guide to the age and for the identification of beds with each other, and by carefully noting the general dip and strike of the more conspicuous beds, it is often possible, especially if an opportunity occurs of retracing the road followed, or of traversing a parallel route, to make out the structure of a country that at first appears hopelessly intricate. Dense forest is perhaps the worst obstacle to geological exploration; snow is another, though not quite so serious a disadvantage. It is always a good plan to climb commanding peaks; the general direction of beds, obscure from the lower ground, not unfrequently becomes much clearer when they are seen from above.

In level and undulating regions, on the other hand, it frequently happens that enormous tracts of country are occupied by the same formation, and if the rocks are soft, and especially if they are horizontal, or nearly so, little, if any, rock is to be seen in place. In this case water-courses should be searched for sections, and the pebbles found in the stream-beds examined, care being taken not to mistake transported

pebbles derived from overlying alluvium or drift for fragments of the underlying rock. Where the same formation prevails over large tracts, it is usually easy, by examining the stones brought down by a stream, to learn whether any other beds occur. It is astonishing how even a small outcrop of hard rock at a remote spot in the area drained by a stream will almost always yield a few fragments that can be detected by walking two or three hundred yards up the stream-bed and carefully examining the pebbles.

Not infrequently different rocks support different vegetation, and by noting the forms that are peculiar, the constitution of hills at a considerable distance may be recognised. Thus some kinds of rock will be found to support evergreen, others deciduous trees, others grass, whilst a fourth kind may be distinguished by the poverty or want of vegetation. It is not well to trust too much to such indications, but they may show which hills require examination and which do not. The form assumed by the outcrop of some hard beds is often characteristic, and may be recognised at a considerable distance.

One most important fact should never be forgotten; mineral character, whether of sedimentary or volcanic rocks, is absolutely worthless as a guide to the age of beds occurring in distant countries. The traveller should never be led to suppose, because a formation, whether sedimentary or volcanic, in a remote part of the world, is mineralogically and structurally identical with another in Europe, or some country of which the geology is well known, that the two are of contemporaneous origin. The blunders that have been made from want of knowledge of this important caution are innumerable.

There are a few points of geological interest well worthy of the investigation of those who traverse unexplored, or partially explored, tracts of the earth's surface. Amongst these are the following:—

Mountain-Chains.—Few, if any, geologists now believe that mountains were simply thrust up from below; all admit that, at least in the majority of cases, where great crumpling of the strata has taken place, there has been lateral movement of the earth's crust. But the causes, extent and date, of the lateral movements are still, to a great degree, matters of conjecture, and every additional series of observations bearing on the question is of importance. There are many mountain-chains of which very little is yet known. In every case good sections are required, drawn

as nearly to scale as practicable, through the range from side to side, and including the rocks at each base. The nature and distribution of all volcanic and crystalline rocks, both in the range and throughout the neighbouring areas, are especially noteworthy, and also the relations of the later beds, if any, on the flanks of the mountains, to those constituting the range itself. The derivation of the materials of the former from the latter, and the relative amount of disturbance shown by the two, and by the different members of each, will afford a clue to the date of upheaval; and two or more periods of movement may thus be determined, where intrusive igneous rocks, such as granite, occur, their relations to the surrounding rocks should be carefully noted, and specimens at the contact of the two rocks collected. If altered sedimentary rocks are found these should be traced, if possible, away from the igneous rock until some indication of their age is obtained from included fossils.

The distinction between a contemporaneous lava flow and an intrusive sheet of igneous rock is not always at first sight apparent; if the latter, it may pass from one bed to another or send tongues upwards into the overlying strata. Search should be made in the beds overlying the igneous rock for signs of alteration by heat. Thus limestone may be re-crystallised into marble, or shales altered into flinty hornstone.

Volcanoes and Volcanic Rocks.—It is almost needless to say that any additional information on the distribution of volcanic vents, recent or extinct, is of interest. In the case of extinct vents, the geological date of the last eruptions should be ascertained if practicable. This may sometimes be determined by finding organic remains or sedimentary beds of known age interstratified with the ashes or lava-streams near the base of the volcano.

Coasts.—The subject of the erosion of coasts is now fairly understood, and there is no doubt that the relative importance of this form of denudation was greatly overrated by many geological writers, who took their ideas of geological denudation generally from the phenomena observed in the islands, and on some of the coasts of Western Europe. Still, wherever cliffs occur, they afford good sections, and deserve examination. One question will usually present itself to almost every geological observer, and that is, whether any coast he may be landing upon affords evidence of elevation or depression. In the former case, beds of rolled pebbles or of marine shells, similar to those now living on the shore, may be found

at some elevation above high-water mark. Very often the commonest molluscs in raised beds are the kinds occurring in estuaries, which are different from those inhabiting an open coast. Caution is necessary, however, that heaps of shells made by man, or isolated specimens transported by animals (birds or hermit-crabs), or by the wind, be not mistaken for evidence of raised beds.* If the shore is steep, terraces on the hill-sides may mark the levels at which the sea remained in past times, but some care is necessary not to mistake outcrops of hard beds for terraces. If dead shells of species of molluscs, only living in salt-water estuaries, are found in places now beyond the influence of the tide, it is a reasonable inference that elevation has taken place.

The evidence of depression, on the other hand, unless there are buildings or trees partly sunk in the water, is much less readily obtained, and neither trees nor buildings are available as evidence, unless the depression is of comparatively recent date. The best proof is the form of the coast. If deep inlets of moderate breadth occur, with numerous branches, a little examination will frequently show whether such inlets are valleys of subaërial erosion, as they not unfrequently are, that have been depressed below the sea. A good and familiar example of such a depressed valley is to be found at Milford Haven in South Wales. In higher latitudes, the coast should be examined for signs of the action of sea ice, and stones should be collected from icebergs which have drifted from outside the accessible area; the shape of these stones and the proportion of those having only one smoothed side should be noted.

Rivers and River-Plains.—At the present time a question of much interest is the antiquity of existing land-areas, and some light may be thrown upon this, if the relations of existing river-basins to those of past times can be determined. If a stream cuts its way through a high range, it is probable that the stream is of greater antiquity than the range, and either once ran at an elevation higher than the crest of the ridge now traversed, or else has cut its way through the range gradually during the slow elevation of the latter. Where a river traverses a great alluvial plain, it may fairly be inferred that a long time has been occupied in the

* In high latitudes care must be exercised in distinguishing between true raised beaches and ridges of beach material pushed up by the pressure of shore ice in winter.

accumulation of the deposits to form the plain; but it remains to be seen whether those deposits are not partly marine or lacustrine. If upheaval has taken place over any portion of the plain, or if the river has cut its bed deeper, sections may be exposed, and these should always be examined for fossil remains. Bones of extinct animals are not unfrequently found in such deposits.*

Lakes and Tarns.—The mode of origin of lakes is always a subject of considerable geological interest, and any evidence which bears on the origin of a particular lake should be carefully noted. Lakes may be divided broadly into two classes: (1) rock basins, (2) impounded hollows. Lakes of the latter class may, as a rule, be readily recognised and accounted for. The material forming the barrier may be due to a moraine, scree, or a landslide, or may result from the presence of a glacier in the main valley damming back the drainage of a lateral tributary. When lakes occur near the summit of a pass, they may often be traced to deposition of delta material on the floor of the valley brought down by a tributary stream. In this case, the inability of the stream to remove the material may often be traced to the abstraction of the head waters of the valley by the encroachment of the stream on the other side of the watershed. Rock basins, on the other hand, are frequently difficult to account for. They may occupy volcanic craters, or lie in areas of special depression (earthquake districts), or synclinal folds. They may be due to upheaval of old valley systems, causing reversal of drainage, or to subsidence at the upper end of a valley.

* In some valleys the lateral tributaries enter at a higher level than the floor of the main valley, owing to the overdeepening of the latter; this overdeepening has been attributed to four different causes:—(1) Inequality in the hardness of the rocks, especially when the main valley runs along the strike; (2) the presence of joints, or other lines of weakness; (3) increased erosion of the main valley by river action owing to the elevation of the upper end of the district, while the lateral valleys were merely tilted sideways, or were protected by the presence of ice or lakes; (4) erosion of the main valley by ice more rapidly than its tributaries, owing to the ice being thicker in the former. The problem is complicated by the fact that the upper end of the main valley is frequently a 'hanging' valley. Any evidence bearing on the formation of these 'hanging' valleys should be carefully noted.

In special cases they may be due to the solution of soluble rock (rock-salt, gypsum, limestone, or dolomite). Many not otherwise explicable have been attributed to ice erosion during glacial periods, and it is still a moot point how far these lakes are due to partial changes in the elevation of the country, some observers having adopted, while many others dispute, the views of the late Sir A. Ramsay, who believed all these hollows to have been scooped out by ice moving over the surface in the form of a glacier or an ice-sheet. The origin of any lake met with should, if possible, be investigated and assigned to one of these causes.

Evidence of Glacial Action.—Closely connected with the subject of lakes is that of glacial evidence generally. There is probably no geological question which has produced more speculation of late years than the inquiry into the traces of a comparatively recent cold period in the earth's history, and the former occurrence of similar glacial epochs at regular or irregular intervals of geological time.

The evidence of the last glacial epoch may be traced in two ways—by the form of the surface, which has been modified by the action of ice, and by changes that have taken place in the fauna and flora of the country in consequence of the alteration in the climate. The effects of an ice-sheet, like that now occurring in Greenland, if such formerly existed in comparatively low latitudes, must have been to round off, score and polish the rocks of the country in a peculiar manner, easily recognised by those familiar with glaciated areas. Care should be taken that the peculiar scoring and grooving of rock surfaces produced by the action of sand transported by the wind be not mistaken for glacial evidence. Cases also occur where movement among a mass of unconsolidated conglomerate or scree material has produced striation of the pebbles; in this case, however, careful observation will disclose a similar striation in the material of the matrix as well. Glaciers, properly so called, are confined to hilly or mountainous countries, and the valleys formerly occupied by them retain more or less the form of the letter U instead of taking the shape of the letter V, as they do when they have been cut out by running water. The sides of the valley, when modified by a glacier, have a tendency to assume the form of slopes unbroken by ravines, and with all ridges planed away or rounded, whilst in ordinary valleys of erosion by water, the sides consist of a series of side valleys or ravines, divided from

each other by sharp ridges running down to the main valley. Large and small masses of rock, preserving to a considerable extent an angular form, but frequently polished and grooved by being ground against the sides or bottom of the valley, are carried down by the ice, and either left behind, perched up high on the slopes of the valley, or accumulated in a vast heap or bank, known as a terminal moraine, at the spot where the ice has terminated, or as lateral moraines on the sides of the valley. The nature of the rock will usually show whether the fragments on the side of a hill or at the bottom of a valley are derived from the higher parts of the drainage area, or whether they have merely fallen down from the neighbouring slopes. In the latter case, they may be due to landslips; in the former, their shape and the erosion they have undergone will aid in showing whether they have been transported by water or ice.

The surfaces that have been modified by earlier glacial epochs must in general have been long since removed by other denuding agencies. The most important evidence of former ice action consists in the occurrence, embedded in fine sediment, of large boulders, occasionally preserving marks of polish and striation, and usually, though not always, angular. Accumulations of this kind afford evidence of transport by two different agencies, water, which has brought the silt, and ice, which has carried the boulders. If the water had been in rapid movement, and thus capable of moving the boulders, it would have carried away fine silt or sand, instead of depositing it. Evidence of ice action has thus been traced equally in the boulder clay of North-Western Europe, and in the Paleozoic boulder beds of India, South Africa, and Australia, and probably of South America.

It is well to search in all mountain ranges for traces of glacial action. In many mountain chains, even in comparatively low latitudes, proofs have been found of the existence of glaciers, at a much lower level than at present, dating from a comparatively recent geological period, whilst in other mountain regions none have been recognised. The question also whether glacial action has been contemporaneous in the two hemispheres is of the greatest importance, and the evidence hitherto adduced is of a very conflicting character.

Deserts.—The great sandy or salt plains, with a more or less barren surface, that occupy a large area in the interior of several continents, have only of late years received due attention from geologists. A great thick-

ness of deposits must occur in many of these vast, nearly level, tracts, for the underlying rocks are often completely concealed over immense areas. The investigation of the deposits is frequently a matter of great difficulty for want of sections; but, where practicable, a careful examination should be made, and exact descriptions of the formations exposed recorded. Some, at all events, of these beds appear to be entirely deposited from the air, and consist of the decomposed surfaces of rocks and the sand and silt from stream deposits, carried up by wind and then redeposited on the surface of the country. Such deposits are very fine, formed of well-rounded grains, and, as a rule, destitute of stratification. The geologist who has especially described these formations, Baron F. von Richthofen, in his work on China, attributes to the loess of the Rhine and Danube valleys a similar origin. It is usual to find beds due to water-action, rain-wash and stream-deposits, interstratified with the subaerial accumulations. Further observations on these formations are desirable. The occurrence of blown sands, the origin of these accumulations, and the peculiar ridges they assume, usually at right angles, but in some remarkable cases parallel to the prevailing winds, are questions deserving of additional elucidation.

Early History of Man in Tropical Climates.—Very little has been discovered as to the races of men formerly inhabiting tropical regions. It is evident that a race unacquainted with fire could only have existed in a country where suitable food was procurable throughout the year, and this must have been in a region possessing a climate like that found in parts of the tropics at the present day. It is possible that an investigation of the cave deposits in the tropics may throw some light on this subject. "Kitchen middens," as they are termed—the mounds that have once been the refuse heaps of human habitations—are also worthy of careful examination.

Permanence of Ocean-Basins.—Within the last few years some geologists have adopted the theory that all the deep-sea area has been the same from the earliest geological times, and that the distinction between the depressions occupied by the oceans and the remaining undepressed portion of the earth's crust, constituting the continents and the shallow seas around their coasts, is permanent. This view is very far from being universally or even generally accepted amongst geologists, although many who hesitate to accept the theory as a whole admit that parts of the

Oceans may have been depressions since the earth's crust was first consolidated.

The argument on both sides depends upon theories to which travellers can contribute but little except by observations on the geology, fauna, and flora of oceanic islands, and by the investigation of coral-reefs and especially of atolls. In ranges of hills or mountains near the coast both of continents and islands and in all tracts where evidence of recent elevation exists, search should be made for deep-sea deposits. These are fine calcareous or argillaceous beds, often containing small Foraminifera or Radiolaria, which, however, are generally extremely minute, and require microscopical examination for detection. If any beds of consolidated calcareous or siliceous ooze or especially if red or gray clay (in older rocks, slate, or even quartzite) be found associated with pelagic deposits, such as coral limestone, a few small fragments of the beds should always be brought away for examination, and any distinct fossil remains found in such beds, for instance echinoderms (sea-urchins or star-fishes) or sharks' teeth, should be carefully preserved with some of the matrix. Deep-sea deposits have recently been discovered in several parts of the world, for instance, the West Indies, the Solomon Islands, the islands of Torres Straits and Southern Australia, as well as in Europe.

Atolls or Coral-Islands.—Each of the remarkable coral islands of the Pacific and Indian oceans consists usually of an irregular ring, part or the whole of which is a few feet above the sea, and which encloses an inner lagoon of no great depth. The outer margin of the reef around each island slopes rapidly, sometimes precipitately, to a depth of, usually, several hundred fathoms. Darwin, taking these facts into consideration, together with the circumstance that no coral-reefs are known to be formed at a greater depth than about 15 to 20 fathoms (90 to 120 feet), showed that all the facts of the case could be explained by the theory that coral-islands were formed in areas of subsidence. This view was generally accepted until Prof. A. Agassiz, Sir John Murray, and other writers brought forward evidence in favour of coral-islands being founded on shoals that may be areas of elevation.

Much light has been thrown on this subject by recent exploration. Two instances in especial may be mentioned. The examination of Christmas Island in the Indian Ocean, South of Sumatra, by Mr. Andrews,

has shown it to be a raised atoll, founded on a volcanic base, whilst, on the other hand, borings on the atoll of Funafuti, one of the Marshall Islands in the Western Pacific, carried to a depth of over 1000 feet on the ring itself, and to 245 feet below sea-level in the middle of the lagoon, have yielded results which, in the opinion of the geologists engaged, Prof. Sollas and Prof. Edgeworth David, completely confirm Darwin's theory.

It is probable that atolls originate in more than one way, some being formed in rising or stationary tracts, others in areas of depression. The important question, from a geographical point of view, is not so much how isolated atolls were formed as whether the great tracts in the Pacific and Indian oceans in which no islands occur except atolls, for instance, the Marshall, Gilbert and Lew archipelagoes in the former, and the Laccadives and Maldives in the latter, have been areas of extensive subsidence during the later geological periods. Further evidence on this question may perhaps in time be furnished by additional borings, for one of which an island of the Maldivian group would furnish an excellent locality, since there is in this case independent evidence to indicate that the archipelago occupies part of a sunken tract. Meantime any additional details would be useful, such as careful soundings around those atolls which have not been fully surveyed, so as to give an accurate profile of the sea-bottom in the neighbourhood.

MEMORANDUM ON GLACIER OBSERVATIONS.

Revised by ALAN G. OGILVIE.

The recent movements of glaciers may be noted by the following signs:—

When the ice is advancing, the glaciers generally have a mere convex outline, the icefalls are more broken into towers and spires, and piles of fresh rubbish are found shot over the grass of the lower moraines. Moraines which have been comparatively recently deposited by advancing ice are disturbed, shew cracks, and are obviously being pushed forward or aside by the glacier. There is a tendency for the glacier to terminate in a vertical front, or "Chinese wall," as distinguished from the sloping snout of a stationary or retreating glacier, owing to the more rapid advance of the upper layers. If the advance is rapid the overhanging

layers will fall, and an ice talus will collect in front. An inspection of the ice will often disclose horizontal lines of sheering which in a side view are seen to rise towards the terminal wall. Search should be made along these sheer planes for included moraine material, and any proofs of elevation of this material noted.

When the ice is in retreat it terminates in a gently sloping snout. The marks of its further recent extension are seen fringing the glacier both at the end and sides in their lower portions, the glacier fails to fill its former bed, and bare stony tracts, often interspersed with pools or lakelets, lie between the end of the glacier and the mounds of recent terminal moraines.

Where a glacier has retreated to any considerable extent, careful observations of the form of its bed are of value. What is the nature of the rock surfaces exposed—convex or concave; are they rubbed smooth on their leesides; how far have the contours of the cliffs or slopes, or the sides of any gorge, been modified where they have been subjected to ice-friction? Is there any evidence that the ice has flowed over large boulders, or loose soils, such as gravel, without disturbing them? How has it affected rocks of different hardness, for instance, veins of quartz in a less hard rock? Generally, do the appearances indicate that the glacier has excavated, or only abraded and polished its bed; that it has scooped out new rock-basins, or only cleaned out, scratched, and preserved from filling-up by alluvial deposits or earthslips, existing basins? What is the general character of the valley bottom and the slopes above and below the most conspicuous ancient moraines?

With a view to ascertaining the oscillations in length of a glacier, the traveller or surveyor should, if possible, mark on the ground the position of the end of the glacier at the time of his visit, so that the next visitor will be able to measure the movement that has taken place since his predecessor's visit. Leaving out of question elaborate trigonometrical methods, such, for instance, as have been carried out on the Rhone Glacier in Switzerland, the following means may be adopted for recording the position of the glacier front with considerable accuracy. Paint some signs on large boulders, not too far from the end of the glacier, and measure their distance from it by a tape (Richter's system), or build a low wall of stones of a few yards in length, and, say 15 to 20 inches in height, some distance from the ice-end, and measure this distance

(Gorret's system). It is to be recommended that the stones of these walls should also be painted. In either case the date and distance should be painted on the stones. If the traveller himself returns after some interval—even after only two or three weeks—he will be able to judge of the movement of the glacier, and he will have laid down a basis for further observations by future travellers. A plane-table sketch on a fairly large scale with contours or form lines of the ice front and its immediate vicinity is of the greatest value, as it records not only the position but also the form of the glacier. The sketch should, of course, show the position of the painted boulders or other fixed points near the ice. To ascertain the recent retreat of a glacier, measure the distance from the ice front to the most advanced terminal moraine, where vegetation first shows itself. The bare ground recently left by glaciers is easily recognisable. The diminution of volume is best measured by ascertaining the height of bare soil left on the sides of the lateral moraines in the portion of the glacier within the zone of vegetation. All photographic representations of the glacier end, and of the ground which has been freed from the glacier ice, are of great value. Those will be of most service that show the position of the glacier-snout with relation to some conspicuous rock or other feature in the local scenery. Each photograph should be dated, and the bearings and distance of the camera with reference to any such feature accurately noted.

Neighbouring glaciers often furnish very different results as regards advance or retreat, owing to the fact that steep glaciers anticipate in their oscillations those the beds of which are less inclined.

One of the results most to be desired is an exact knowledge of the dates:

- I. Of the maximum extension of the ice.
- II. Of the commencement of retreat.
- III. Of the minimum.
- IV. Of the commencement of fresh increase.

and even information giving approximate dates—say, to within a decade, may prove to be of value.

In dealing with a mountain group, therefore, the traveller should note (where he can get the information as to the past) the date of the

commencement of the actual movement of *each glacier*, and in all cases whether the ice is in advance, or retreat, or stationary. Of course the rate of forward movement, or velocity of the ice, and the oscillations in the extension of the ice must be kept carefully distinct. Observations should also be made on the presence of blue bands, and their relation to the lines of stratification in the *névé* noted.

Should time and circumstances permit, a series of observations of the velocity of the ice is of value. These may be made after Tyndall's method, by planting a line of sticks across the glacier, or by painting marks on boulders, the position of which relatively to ascertained points on the mountain-side has been accurately fixed. The size of the glacier that is, the area of its basin and its length, also the slope of its bed above, as well as at the point measured, should be noted. The rate of movement of the ice appears to be connected both with the volume of the glacier and the inclination of its bed, and is considerably affected by temperature. Thus a rise in temperature may even be accompanied by a temporary advance, but in this case a sagging will take place higher in the *névé*, producing a concave cross-section, showing that the advance is not due to increased snowfall, but to a decrease in the viscosity of the ice.

The advance or retreat of a glacier are not the only factors to take into account in estimating the decrease or diminution of the volume of ice. The highest level of the transverse convexity of the glacier at various points in its course should also be noted. If the glacier is bounded laterally by rocky walls, marks may conveniently be painted on these, opposite one another. The vertical height of the marks above the ice at the sides should be noted, and the date of the observation recorded.

A society, entitled the Commission Internationale des Glaciers, has been formed to promote the study of glacial movements and other points of interest and importance. Their reports from their inception to 1905 were published in the 'Archives des Sciences,' Geneva, the journal of the Swiss Alpine Club, and from 1906 to 1913 in the 'Zeitschrift für Gletscherkunde,' Berlin. A summary of the reports in English appeared throughout these years in the 'Journal of Geology,' Washington. The European War has disorganised this international society, but steps are being taken to establish some organisation to replace it.

IV.

NATURAL HISTORY.*

By the late H. W. BATES, F.R.S.

Revised by W. R. OGILVIE-GRANT,
British Museum (Natural History).

In the present state of Biological Science, travellers who intend to devote themselves specially to the zoological or botanical investigation of new or little-known countries, require to be trained for the work beforehand, and are consequently well-informed as to methods and appliances. It is not for them that these 'Hints' are drawn up, but for general travellers and explorers, who, whilst engaged chiefly in survey, wish to know how best to profit by their opportunities of benefiting science by collecting examples of new or rare species, and how to preserve and safely transmit their specimens. The observations refer only to explorations by land.

Outfit†—

A magazine sporting rifle, either Mannlicher .256, or Lee-Enfield .303, and ammunition (solid and soft-nosed, split or hollow-point bullets).

Double-barrel 12-bore gun—for choice a Keeper's hammerless non-ejector gun and ammunition (Nos. 3 and 5 shot).‡

* Travellers who intend to make collections of zoological specimens are advised to call on the Secretary of the British Museum (Natural History), Cromwell Road, S.W. He will be happy to supply any information required.

† General travelling outfit can be procured from Messrs. Silver & Co., 67 Cornhill, E.C.

‡ Ejector guns are apt to get out of order in sandy countries.

Double-barrel .410 hammer-gun and ammunition (Nos. 8, 10 and 12 shot).

Cartridges with a full charge of powder and No. 8 shot will kill larger birds at a considerable distance; those with Nos. 10 and 12 shot are specially loaded for collecting smaller birds at closer quarters, and may be used at distances of from fifteen to twenty-five yards without damaging the specimens. The loads are: $\frac{3}{4}$ oz. No. 12 shot, $\frac{1}{2}$ dr. black powder, or 9 grains Schultze; $\frac{1}{2}$ oz. No. 10 shot, $\frac{1}{2}$ dr. black powder, or 9 grains Schultze. In damp climates black powder will be found more reliable. If shot larger than No. 8 is used with this gun, the pattern is erratic and the result uncertain. Messrs. Cogswell and Harrison, 226 Strand, W.C., have had considerable experience in loading cartridges for these guns, and their Nos. 10 and 12 shot is even and carefully screened.

No. 1 saloon pistol and ammunition (turned-over caps with dust shot). This pistol will be found of great value for collecting small birds at very close quarters in thick cover, or the more active lizards. It can be easily carried in a holster on a belt, to which is also attached a small pouch for ammunition. Small brass turned-over caps, loaded with a pinch of dust-shot, can be had of Messrs. Cogswell and Harrison.

Telescope.

Binocular field-glasses.

Traps can be procured from Mr. S. J. Beckett, 89 Dresden Road, Highgate, N. (apply, in the first place, by letter). For catching hyenas, etc., large traps are supplied; for smaller mammals, Brailsford live-traps and Cyclone and Schuyler break-back traps are the best, and should be procured in several sizes. Pitfall-traps made by sinking earthenware jars flush with the ground are also useful.

Several air-tight zinc-lined collecting boxes, fitted with light wooden trays. These are made by Messrs. Lovelace and Co., 20 Gloucester Road, S.W., and will be found extremely serviceable for packing, storing, and transmitting skins of smaller mammals and birds. When starting they can be packed full of stores. Uniform cases

may be substituted, but, unless protected by wooden travelling-covers, are liable to get damaged and to admit insects.

A set of carpenter's tools; screws and French nails of various sizes.

A set of soldering irons and soft solder, etc.

For skinning large Mammals—*

2 shoemakers' knives.†

3 large scalpels.*

1 small saw.†

1 pair cutting-pincers.†

1 pair pliers.†

For skinning small Mammals and Birds—*

Taxidermist's box containing:

6 scalpels.†

1 oil-stone.†

2 pairs of scissors (one short-bladed, one dissecting).†

2 pairs of tow-pliers (like curling-irons, for inserting tow or cotton-wool into the necks of bird-skins).†

1 pair of forceps.†

1 pair of tweezers.†

1 pair cutting-pliers.†

1 pair compasses.†

1 2-foot rule marked in tenths of an inch.†

1 millimetre rule.

3 darning needles.†

Needles and thread.

1 tin of mixed pins.

Bundles of galvanized wire (for inserting in tails of small mammals and in necks of bird-skins).

3 hog-hair brushes for applying arsenical soap.

2 egg-drills (two sizes).†

2 blow-pipes (two sizes).†

2 pencils.

1 small biscuit tin of fine boxwood sawdust.

1 2-lb. tin of candle naphthaline.

1 2-lb. tin crystal.

1 2-lb. tin plaster of Paris.

- 3 1-lb. tins of arsenical soap (in treacle tins), or the same weight of powdered arsenic.
- 1 2-lb. tin burnt alum.
- 1000 labels for bird-skins.
- 500 labels for small mammals.
- 2 bundles of wool.
- Tow (which can be used as packing).
- 6 pieces of fine mesh wire-netting (for making cages, etc.).

* All the articles mentioned in this list can be best procured from Mr. S. J. Rockett, 39 Dresden Road, Highgate, N. Apply, in first place, by letter.

† Those marked with a cross (†) can be obtained from Messrs. Buck, 242 Tottenham Court Road, W.C.

For preserving Reptiles, Batrachians, and Fish—

These should be preserved in spirits whenever practicable.

For larger specimens—

- 2 or 4 four-sided copper tanks with a round opening of six inches diameter, closed with a screw cover. Each tank is fitted into a strong wooden case with a lid secured by hinges and lock, and furnished on two opposite sides with a rope handle.

For smaller specimens liable to be damaged—

- 2 or 4 wooden cases divided into four or six compartments, each containing a pickle jar, with glass rubber-edged stopper secured by an adjustable iron fastening.

3 dozen or more corked glass tubes of various sizes.

A supply of sheets of zinc, soldering irons and soft solder (to make extra tanks).

1000 parchment labels bearing numbers.

If the above specially constructed zinc tanks cannot be procured, wide-mouthed earthenware jars, tightly closed with cork or rubber, may be used.

The glass tubes will be found specially useful for collecting Arachnida, Myriopoda, small Mollusca, etc.

For collecting Insects—

Store boxes lined with cork-carpet.

Triangular envelopes of smooth foolscap paper for butterflies and thin-bodied moths.

Card fly-discs.

Entomological pins (boxes of various sizes).

2 zinc oval pocket boxes lined with cork-carpet (two sizes).

6 or more sets (four each) of glass-bottomed pill-boxes covered with jaconet.

2 pairs of entomological forceps.

4 insect killing-bottles (two sizes) in leather cases. (Hinton & Co., 88 Bedford Street, Strand, W.C.)

A small bottle of oxalic acid, with stabbing quill fixed in cork, for killing large insects.

2 flat killing-bottles for beetles, with glass tube passing through the cork and fitted with a cork plug.

2 small entomological lamps.

6 tins of bicycle oil.

1 dozen 1-lb. tins of golden syrup or treacle.

2 sugar brushes.

1 8-oz. bottle of acetate of amyl ("Essence of Pear Drops," for mixing with treacle) (Hinton & Co.).

3 butterfly-nets (two round, one kite-shaped) with extra bags.*

1 water-net (for aquatic insects).

Several pieces of cork-carpet about a foot square (for making extra store boxes).

1 pocket lens.

2 large pickle-jars of carbolized sawdust to be used as packing for beetles after they have been killed.

3 dozen corked glass tubes (three sizes).†

† All the above-mentioned articles for collecting insects may be procured from Mr. Janson, 44 Great Russell Street, W., or from Messrs. Watkins & Doncaster, 86 Strand, W.C., or from Miss E. M. Sharpe, 4 Barrowgate Road, Chiswick.

* The shafts of old golf-drivers, when shortened to about 2 feet 6 inches in length, make the most perfect handles for nets.

For instructions regarding the collecting and preservation of specimens in all branches of natural history, travellers and others are recommended to provide themselves with a 'Handbook of Instructions for Collectors,' issued by the British Museum (Natural History). With illustrations. Second edition, 1904. Price 1s. 6d.

In humid tropical countries, where the ubiquitous ants are likely to destroy specimens before they are ready to be packed away, drying-cages, suspended from the roof of a hut or tent, are absolutely necessary. These can be readily made from old packing-cases, but a few square feet of wire gauze must be provided for the back and front of the cages, and the cord by which they are suspended must be threaded through a small calabash containing oil, or, better still, naphthaline, to prevent ants from descending from the roof. The cages may be so arranged as to



be taken to pieces and put together again readily; one, for birds, should be about 2 feet 6 inches long by 1 foot 6 inches high and 1 foot broad; the other, for insects and other small specimens, may be about one-third less. They should have folding doors in front, with panels of wire gauze, and the backs wholly of the latter material; the sides fitted with racks to hold six or eight plain shelves, which in the smaller cage should be covered with cork, or any soft wood that can be obtained in tropical countries. A strong ring fixed in the top of the cage, with a cord having a hook attached at the end by which to hang it in an airy place, will keep the contained specimens out of harm's way until they are quite dry, when they may be stowed away in suitable close-fitting boxes. An even simpler and perfectly effective plan is to take a number of pieces of stout wire each about 18 inches long, bend each end into a loop, and round the middle solder a funnel-shaped piece of tin to contain powdered candle-naphthaline. The upper loop of each wire can be secured with string to a rafter, and between the lower loops flat boards, or a series of boards, can be suspended on which skins may be placed to dry. This method has been proved to be safe, no ants ever venturing to cross the naphthaline.

A few yards of india-rubber waterproof sheeting may be found useful as a temporary covering to collections in wet weather or in crossing rivers. To those who have had little or no experience in field-collecting it may

be useful to give some idea of the impedimenta considered absolutely essential for an ordinary day's work when it is desired to collect, as far as possible, in all branches of zoology, and the most convenient means of disposing of such. The collector should be accompanied, if possible, by two intelligent natives to act as bearers, who may, with patience, be developed into useful assistant-collectors.

A 12-bore gun or rifle, according to circumstances, with ammunition, to be carried by the first bearer.

A .410 collecting gun and twenty-five cartridges, including a few cartridges with full loads of 8 shot: the cartridges to be carried by self, the gun, when not in use, to be carried by the second bearer. The 10 shot and 12 shot .410 cartridges should be carried in the two lower waistcoat pockets, where they are easily accessible, and the few 8 shot cartridges in some other pocket.

Saloon pistol in holster with pouch for carrying ammunition on belt, strapped round the waist, so that it can be easily and quickly made use of.

A butterfly-net carried by self, or by the second bearer if not in use.

Large oval zinc pocket-box lined with cork carpet, containing a stock of pins, both large and small, stuck in one side of the cork carpet ready for use; to be carried in the right-hand side-pocket of the coat.

Entomological forceps, pointed forceps, and larger forceps for picking up scorpions, large spiders, etc., and entomological killing-bottle; to be carried in the left-hand side-pocket of the coat.

Two larger-sized corked glass tubes half-full of spirits and a camel's-hair brush to be carried in the right and left top waistcoat-pockets, for collecting small spiders, etc. It is difficult to pick up the swift-running ground-haunting species without injury, but, by dipping the brush in spirits and placing it on them, they are at once stupefied, and may then be easily transferred to the tube.

The spirit is also required for saturating the small plug of cotton-wool to be pushed down the throat of each bird as soon as it has been killed; the gape should then be plugged with dry cotton. Specimens thus prepared may be carried, even in a hot climate, for several hours without deteriorating.

A game bag carried by the second bearer, with a large supply of paper for wrapping up birds when shot.

Several sets of glass-top pill-boxes carried in the 'hare'-pocket, or in one of the pockets of the game-bag, to which they can be transferred when filled.

A pickle pot in Willesden canvas or basket-work cover with handle, half filled with spirits, for collecting small snakes, lizards, frogs, scorpions, etc.; to be carried by the first bearer, who should be instructed how to hunt for reptiles, etc.

If possible, a beetle-killing bottle should be added to the above impedimenta, and may be carried in the left-hand breast-pocket of the coat.

A Norfolk coat is a most useful article of clothing, and should be provided with a deep 'hare' pocket running round the skirt and divided in the middle.

After a very short time the collector will be able to find any article he may require by instinct, and without loss of time. To have a pocket for each article, and to know where it is, saves an infinity of trouble.

At daylight the traps should be visited, and any specimens to be preserved should at once be sent back into camp.

Collecting should always, if possible, be vigorously prosecuted during the early morning hours, when birds, etc., are feeding, and are much more easily procured.

When butterflies and thick-bodied moths are placed in the killing-bottle, care should be taken to see that they die with their wings turned the 'right way,' i.e., with the underside outermost. Those which die with the upper side outermost should be at once reversed with the aid of a pin or the sharp-pointed forceps, and then replaced in the bottle. If not attended to at once they become rigid, and the wings get rubbed and spoilt before they are quite dead.

Where and what to collect.—The countries which are now the least known with regard to their natural history are New Guinea and some of the large islands to the east of it, East Sumatra, the highlands of Mindanao and other Philippine Islands, Formosa, Tibet, Indo-China, and other parts of Central Asia, Equatorial Africa, and Central South America. A special interest attaches to the indigenous products of oceanic islands, i.e., islands separated by a deep sea from any large tract of land. Those who have opportunities could not fail to make interesting discoveries by collecting specimens of the smaller animals (insects, molluses, etc.) and plants in these isolated localities. Both in con-

tinental countries and on islands the truly indigenous species will have to be sought for on hills and in the remote parts, where they are more likely to have escaped extermination by settlers and the domestic animals introduced by them. In most of the better-known countries the botany has been better investigated than the zoology, and in all these there still remains much to be done in ascertaining the exact station, and the range, both vertical and horizontal, of known species of animals and plants. This leads us to one point which cannot be too strongly insisted on, namely, that some effective means should be adopted by the traveller to record the *exact locality* and *date* of every specimen he collects.*

A traveller may be puzzled, in the midst of the profusion of animal and vegetable forms which he sees around him, to know what to collect and what to leave. Books can be of little service to him on a journey, and he had better at once abandon all idea of encumbering himself with them. A few days study at the principal museums before he starts on his voyage may teach him a great deal, and the cultivation of a habit of close observation and minute comparison of the specimens he obtains will teach him a great deal more. As a general rule all specimens which he may meet with for the first time far in the interior should be preferred to those common near the civilised parts, and he should bear in mind that the few handsome kinds which attract the attention of the natives, and are offered for sale to strangers, are almost sure to be of species well known in European museums. He should strive to obtain as much variety as possible, and not fill his boxes and jars with quantities of specimens of one or a few species, but as some of the rarest and most interesting species closely resemble others which may be more common, he should avail himself of every opportunity of comparing the objects side by side. In most countries, as already remarked, the truly indigenous, and often the rarest, species are to be found only in the mountains at considerable elevations and in the primitive forests, the products of cultivated districts being nearly all widely distributed and well known. In Botany a traveller, if obliged to restrict his collecting, might confine himself to those plants which are remarkable for their economic uses; always taking care to identify the flowers of the tree or shrub whose root, bark, leaves, wood, etc., are used by the natives, and to preserve a few specimens of them.

* Cf. British Museum 'Handbook,' p. 47.

But if he has the good fortune to ascend any high mountain not previously explored, he should make as complete a collection of the flowering plants as possible, at the higher elevations. The same may be said of insects found on mountains, where they occur in great diversity—on the shady and cold sides rather than on the sunny slopes—under stones, and about the roots of herbage, especially near springs, on shrubs and low trees, and so forth; for upon a knowledge of the plants and insects of mountain ranges depend the solution of many curious questions regarding the geographical distribution of forms over the earth. In Reptiles, the smaller Batrachians (Frogs, Salamanders, etc.) should not be neglected, especially the extremely numerous family of tree-frogs; the arboreal, or rock-haunting species of Lizards seen out of reach, and the swift-running forms that inhabit sandy plains may be secured with a charge of dust-shot, the saloon pistol being especially handy for this purpose. Snakes should be taken without injuring the head, which is the most important part of the body: a cleft stick may be used in securing them by the neck, or they may be shot, and on reaching camp placed in the jars of spirits. As large a collection as possible should be made of the smaller Fishes and Tortoises of lakes and rivers.

*Mammals and Birds.**—An ordinary geographical expedition will hardly have the means at its disposal for bringing home many specimens of the larger animals, but many species in regions visited only by adventurous explorers are still desiderata in the large museums of Europe; and additional specimens of all genera of which there are numerous closely allied species (*e.g.*, Rodents, Antelope, Deer, etc.), and of all the small nocturnal mammals would be welcome to zoologists. If only portions can be obtained, skulls with horns attached are to be preferred. The smaller birds shot on an excursion should be carried to camp in the game bag, folded in paper, the mouth, anus and any wounds being first plugged with cotton-wool. In a hot climate when the birds have to be carried for some distance before they are skinned, a plug of cotton-wool dipped in a weak solution of formaline or in spirits should be pushed down the gullet into the stomach, before the mouth is plugged with dry cotton-wool. This precaution will insure specimens remaining fresh for many hours.

* Cf. British Museum 'Handbook,' pp. 15-32.

Small dull-coloured birds are most likely to be new or interesting.

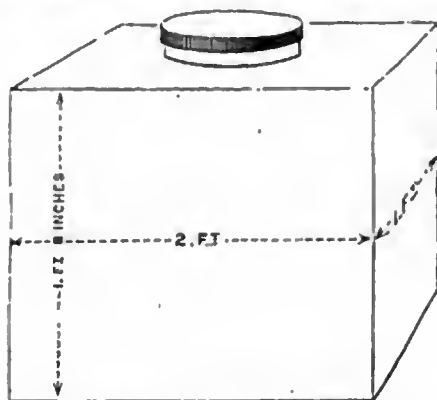
Immediately after killing a small mammal or bird, make a note of the colour of its eyes and soft parts, and, if time admits, of the dimensions of its trunk and limbs. Full directions for skinning will be found in the British Museum 'Handbook,' pp. 15-29. It should however be mentioned that in large-headed Parrots, Woodpeckers, Ducks, and some other birds, in which the skin of the head cannot be turned back, an incision has to be made in the nape, through which the skull can be pushed and cleansed, the incision being afterwards closed by two or three stitches. In finishing the skin of a bird the feet should be placed side by side, with the claws folded and fastened together by means of a pin run transversely through the soles. The protruding ends of the pin can afterwards be cut off close to the feet. This is Mr. W. Foster's plan, and is by far the best and neatest method. When the skin is dry, it should be laid on its back in one of the trays fitted into the zinc-lined collecting boxes, and secured by means of a couple of stout pins passed through the head at the base of the lower mandible and through the root of the tail. By dovetailing the specimens into one another, they can thus be packed with the least loss of space, and need not again be moved. They require no wrapping or paper, and are much more easily looked over to see that no insects have attacked them.

Preserving Mammals, etc., in Alcohol.—When Mammals cannot be prepared as skins with skulls, according to the British Museum directions, they may prove of service if preserved in spirits. Indeed, when a series of skins has been made, additional specimens may well be placed in spirits, while in the case of Bats half the individuals taken of any species should be skinned and half put in spirits.

On the subject of the preservation of such spirit specimens, the late Dr. G. E. Dobson has published the following 'Hints':—

The general collecting case should be made of strong block tin, or, better still, of copper, rectangular in form, about 2 feet x 1 foot x 1 foot 8 inches in height, having in the top a circular aperture from 6 to 8 inches in diameter, closed by a well-fitting brass screw-cap, the flange of which is made air-tight by a well-greased leather collar. This should fit accurately into a similarly shaped box of inch boards, having a simple flat lid (not projecting beyond the sides), secured by eight long screws, and provided with a strong iron handle.

This case should be filled with the strongest methylated spirits procurable (in foreign countries over-proof rum, brandy, or arrack will suit equally well). If circumstances admit, two or more such cases should be taken, or four wide-mouthed earthenware jars placed in a square wooden case, separated by light wooden partitions, and having their mouths closed by well-fitting bungs tied down with bladder and string. On arrival at the collecting station one of the jars should be half filled with spirits from the tin case. Into this each specimen, as it is obtained, having been slit along the side of the abdomen, should be



GENERAL COLLECTING-CASE.

put, and allowed to remain 24 hours before being transferred to the general collecting case. When the latter can hold no more the specimens should be removed one by one and packed in the moist state in the other wide-mouthed jars, one above the other, like herrings in a cask, each rolled in a piece of thin cotton cloth, in which a label, having the locality and date written in pencil, should be placed. When the jar has been thus filled to the mouth a glass or two of the strong spirits (kept in reserve) should be poured in so as to fill up the interstices, but not to appear on the surface, which should be covered with a thick layer of cotton-wool. A few drops of carbolic acid, if the spirit be weak, will greatly aid its pre-

serving powers. The bung should then be replaced, secured round the margin outside with a mixture of tallow and wax, and tied down securely with bladder or skin, and the name of the collector and district written legibly outside. The jar is now ready for transmission to any distance, for specimens thus treated will keep good in the vapour alone of strong spirits for months. Other jars may be filled in like manner, and finally, the general collecting case. Incisions should invariably be made in the *sides* (not in the centre line) of all animals, so as to allow the spirits to enter, and no part of the intestines should be removed. In the case of *Tortoises* the opening may be made in the soft parts round the thigh; if this be not done, the body soon becomes distended with gases. *Frogs* should always be first placed in weak spirits, and after being soaked for one or two days, be removed to strong alcohol. *Crabs* should be rolled up alive in thin cotton-cloths, secured by thread tied round, and may then be readily killed by immersion in alcohol; if this be not done they lose many of their limbs in their dying struggles.

Preparation of Skeletons of Animals.—In many cases it will be found impossible to preserve the whole animal, especially if of large size, but it may advantageously be converted into a skeleton by attention to the following directions of the late Sir W. H. Flower, F.R.S.

If the animal is of small size—say not larger than a Fox—take off the skin except from the feet below the wrist and ankle joints. If it is intended to preserve the skin as a zoological specimen as well as the skeleton, the bones of the feet should all be left in the skin; they can be easily extracted afterwards, and will be preserved much more safely in their natural covering. Remove all the contents of the abdominal and thoracic cavities; also the larynx, gullet, and tongue. In doing this be careful to leave attached to the base of the skull the chain of bones which supports the root of the tongue. These may either be left in connection with the skull, or cleaned separately and tied to the skeleton. Then clear away, with the aid of a knife, as much as possible of the flesh from the head, body, and limbs, without cutting or scraping the bones, or separating them from each other. At any intervals that may be necessary during this process it will be desirable, if practicable, to leave the body in water, so as to wash away as much of the blood as possible from the bones, and a few days' soaking in water frequently changed will be an advantage.

The body, with all the bones held in connection by their ligaments, should then be hung up to dry in a place where there is a free current of air, and out of the way of attacks from animals of prey. Before they get hard the limbs may be folded by the side of the body in the most convenient position, or they may be detached and placed inside the trunk.

When thoroughly dry the skeletons may be packed in boxes with any convenient light packing material between them. Each should be well wrapped in a separate piece of paper or canvas, as sometimes insects will attack the ligamentary structures and allow the bones to come apart.

If it can be avoided, skeletons should never be packed up so long as any moisture remains in them, as otherwise decomposition will go on in the still adhering soft parts, and cause an unpleasant smell.

If the animal is of larger size it will be most convenient to take it partially to pieces before or during the cleaning. The head may be separated from the neck, the vertebral column divided into two or more pieces, and the limbs detached from the trunk; but in no case should the small bones of the feet be separated from one another. The parts should then be treated as above described, and all packed together in a canvas bag.

In the cetacea (porpoises, etc.), look for two small bones suspended in the flesh, just below the vertebral column, at the junction of the lumbar and caudal regions (marked externally by the anal aperture). They are the only rudiments of the pelvis, and should always be preserved with the skeleton.

If there is no opportunity of preserving and transporting entire skeletons, the skulls alone may be kept. They should be treated as above described, picked nearly clean, the brain being scooped out through the *foramen magnum*, soaked for a few days in water, and dried.

Every specimen should be carefully labelled with the popular name of the animal, if known, and at all events, with the sex, the *exact locality* at which it was procured, and the *date*.

For the purpose of making entire skeletons, select, if possible, adult animals; but the skulls of animals of all ages may be advantageously collected.

Collectors of skins should always leave the skull intact. It should be taken out, labelled with a corresponding number to that on the skin, and dried with as much flesh on it as possible.

Reptiles and Fishes.—Full directions for preserving these will be found in the British Museum 'Handbook,' pp. 38-47. The following 'hints' were prepared by the late Mr. Osbert Salvin, F.R.S., who collected these animals most successfully in Guatemala:—

Almost any spirit will answer for this purpose, its fitness consisting in the amount of alcohol contained in it. In all cases it is best to procure the strongest possible, as it is less bulky, and water can always be obtained to reduce the strength to the requisite amount. When the spirit sold retail by the natives is not sufficiently strong, by visiting the distillery the traveller can often obtain the first runnings (the strongest) of the still, which will be stronger than he requires undiluted. The spirit used should be reduced to about 20° over proof, and the traveller should always be provided with an alcoholometer. If this is not at hand, a little practice will enable him to ascertain the strength of the spirit from the rapidity with which the bubbles break when rising to the surface of a small quantity shaken in a bottle. When the spirit has been used this test is of no value. When reptiles or fish are first immersed, it will be found that the spirit becomes rapidly weaker. Large specimens absorb the alcohol very speedily. The rapidity with which this absorption takes place should be carefully watched, and in warm climates the liquid tested at least every twelve hours, and fresh spirit added to restore it to its original strength. In colder climates it is not requisite to watch so closely, but practice will show what attention is necessary. It will be found that absorption of alcohol will be about proportionate to the rate of decomposition. Spirit should not be used too strong, as its effect is to contract the outer surface, and close the pores, thus preventing the alcohol from penetrating through to the inner parts of the specimen. *The principal point, then, is to watch that the strength of the spirit does not get below a certain point while the specimen is absorbing alcohol when first put in.* It will be found that after a few days the spirit retains its strength: when this is the case, the specimen will be perfectly preserved. Spirit should not be thrown away, no matter how often used, so long as the traveller has a reserve of sufficient strength to bring it back to its requisite strength.

In selecting specimens for immersion, regard must be paid to the means at the traveller's disposal. Fishes up to 9 inches long may be placed in spirit, after a slit has been cut in the side of the belly to allow

the spirit to enter to the entrails. With larger specimens, it is better to pass a long knife outside the ribs, so as to separate the muscles on each side of the vertebrae. It is also as well to remove as much food from the entrails as possible, taking care to leave all these in. The larger specimens can be skinned, leaving, however, the intestines in, and simply removing the flesh. Very large specimens preserved in this way absorb very little spirit. All half-digested food should be removed from snakes and animals. In spite of these precautions, specimens will often appear to be decomposing; but, by more constant attention to re-strengthening the spirit, they can, in most cases, be preserved.

A case (copper is the best), with a top that can be unscrewed and refixed easily, should always be carried as a receptacle. The opening should be large enough to allow the hand to be inserted; this is to hold freshly-caught specimens. When they have become preserved, they can all be removed and soldered up in tin or zinc boxes. Zinc is best, as it does not corrode so easily. The traveller will find it very convenient to take lessons in soldering, and to be able to make his own boxes. If he takes them ready-made, they had best be arranged so as to fit one into another before they are filled. When moving about, all specimens should be wrapped in calico or linen or other rags to prevent their rubbing one against the other. This should also be done to the specimens in the copper case when a move is necessary, as well as to those finally packed for transmission to Europe. These last should have all the interstices between the specimens filled in with cotton-wool or rags. If a leak should occur in a case, specimens thus packed will still be maintained moist, and will keep some time without much injury. Proof spirit should be used when the specimens are finally packed, but it is not necessary that it should be fresh.

*Land and Fresh-water Mollusca.** Full instructions for collecting these will be found in the 'British Museum Handbook,' pp. 118-115. Lieut.-Col. H. H. Godwin-Austen, F.R.S., has contributed the following notes on collecting these animals: Mollusca are always most abundant on limestone rocks, and should be searched for under the larger stones

* Much useful information may be found in the 'Manual of the Mollusca,' by S. P. Woodward, F.R.S., one of Weale's series; an admirable book in a small form.

lying about the ground, and under fallen trees and logs in the woods and forests. They may generally be found adhering to the surface of the stone or wood. Many species are often only 0·05 inch in length, so that very close examination is necessary. In damp spots, generally in ravines with a northerly aspect, the dead leaves when damp with dew in the early morning may be turned over one by one, and the under surface examined for minute species; larger species will be found very frequently on the surface of the ground below the layer of decaying vegetable matter. Many may also be secured by tearing off the bark of decaying trees. In the drier parts of the country some species are only to be found among the roots of shrubs, at considerable depth; by digging these up and shaking the earth on to paper, small shells may be found on close examination. At a dry place like Aden, I should expect to find most of the living land-shells in such a habitat. Look well in limestone caves on the damp surface of the rock; some forms hide themselves under a coating of earthy matter. Search also on damp moss and rocks near waterfalls.

Some species will be found high up on the bushes and trees. This is the habit of certain African forms especially; not so in India. A very good idea of the land-shells of a country may at first be obtained by the examination of the beds of the streams, either along the highest flood-line, or in the fine sand and mud collected in the bed. Land-shells found in such situations are usually old and bleached, but the living specimens will not be far off.

The leaves and stems of water plants should be examined, and *Confervee* taken out of the water and well washed in a basin; in these, and in the mud of ponds and still rivers, many minute shells may be found.

The best way of preserving minute shells is to put them into glass tubes plugged with wool; it is better than cork. Capital collecting tubes can be made out of the smaller sorts of bamboo and the large grasses. A certain number of every species (at least a dozen) should be preserved in spirits for the sake of the anatomy. It is best to kill them first in water and then put them into spirits; if this is not done they contract, so that it is impossible to form any idea of the form of the mantle and other parts, and they become so hard they are difficult to cut up.

A good method of keeping the small shells and slugs, especially in spirits, is to put them with labels into small tubes plugged with wool, and then place the tubes in a large jar, capable of holding three or four dozen.

Other small shells, $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in diameter, may be put into pill-boxes at once, for in a dry climate they very soon dry up. The very large animals may be removed by boiling them in water, but when time does not admit of attending to the cleaning of the shells, species, such as Unios, may be put into empty soup-tins and then filled up with dry sand.

It is very important to make a few notes on the colour of the animal, attaching a number for reference on the box or in the tube, and the operculum, when present, should always be preserved.

With respect to slugs, note the surface of the mantle, and always the form of the extremity of the foot, whether pointed or provided with a mucous pore; and again the lobes of the mantle. Preserve them in spirits as above. Drawings from the living animal are invaluable, and should be made if possible. Very little is known of the Asiatic forms; they are of much interest, and have been very little collected.

Insects.—For the best means of preserving the various orders of insects the traveller should consult the 'British Museum Handbook,' pp. 48-89.

Botanical Collecting.—Full instructions will be found in the 'British Museum Handbook,' pp. 116-125.

The following instructions have been prepared by the late Mr. J. Ball, F.R.S.:—

To obtain good specimens of dried plants in a condition serviceable to scientific men, the following are the chief points to be observed:—

1. *Selection of Specimens*.—The object is to give as much information as possible respecting the plant which it is intended to collect. Small plants not exceeding 16 inches in height should be collected *entire with the roots*. Slender plants of greater dimensions may be folded to the same length, and may often be collected entire. Of larger plants, shrubs and trees, the object is to show as much as possible of the plant within the limit of the size of your drying paper. As an universal rule, both the flower and fruit (seed-vessel) should, if possible, be preserved. Of those plants whereon the male and female flowers grow separately, specimens of both should, if possible, be collected.

2. *Conveyance of Specimens to Camp or Station*.—Tin boxes made for the purpose are generally used in Europe for carrying botanical specimens until they can be placed in the drying press. They answer sufficiently well in cool weather, but in hot countries specimens are often partly

withered before they can be laid out; and a rough portfolio, into which the plants can be put when (or soon after) they are gathered, is much to be preferred.

Such a portfolio is easily prepared with two sheets of millboard connected by an endless tape, so as to be easily slung over the shoulder; between these about thirty or forty sheets (60 to 80 folds) of thin soft (more or less bibulous) paper may be carried and kept in place by a strap or piece of twine. With two such portfolios a traveller can carry as many plants as it is possible to collect with advantage in a day. As soon as possible after being gathered, the specimens should be laid roughly between the sheets of paper: except in the case of delicate flowers, no special care is needed, and no harm comes of two or three being put together.

8. *The Drying Press*.—The great object, both to secure good specimens and to save labour and weight of paper, is to get the plants dried quickly,

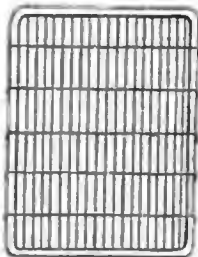


and for this one of the first conditions is to lose as little time as possible. When practicable, the specimens should always be put in the press on the same day on which they are gathered. The press should be made with two outer gratings of iron wire; the outer frame of strong wire, about a quarter of an inch in diameter—the size being that of the paper used. Between these the paper is laid. As to the choice of drying paper, the general rule is, that the coarser it is the better, provided it be quite or nearly quite free from size.

To enable the plants to dry quickly, the traveller should be provided with light wooden gratings of the same size as the drying paper. I think the size 18 inches \times 12 inches is quite large enough. The iron wire outer gratings may with advantage be a quarter of an inch longer and broader to save the edges of the wooden gratings.

These should be made of light laths fastened with a few nails (all the better if these are of copper), the interstices should be rather less than

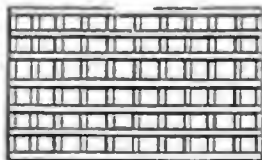
three-quarters of an inch, at all events not more. Their use is to allow the air to circulate through the pile of plants that are being dried. One should be inserted at each interval of about two inches (counting the drying paper and the plants laid out for drying), and when this is done the parcel may with advantage be exposed to the sun or placed near a fire, as the case may be. In dry warm climates, the majority of plants



may be dried in the course of a few days, and will be fit to pack up, without any need of changing the drying paper in which they were originally placed; but in damp weather, and in regard to plants of thick fleshy foliage, it is usually necessary to change the paper more than once before the specimens are thoroughly dry.



GRATING SEEN FROM THE EDGE.



GRATING SEEN FROM ABOVE.

The pile of paper, with plants between each five or six thicknesses of paper, and gratings at intervals of about two inches, should be squeezed between the outer (iron) gratings by means of two strong straps. Too much pressure is not desirable. For a pile ten or twelve inches thick, the parcel may be pulled nearly as tight as a moderate man can do it; but in proportion as the thickness is less, the pressure should be moderated.

Plants with fleshy leaves are very difficult to dry well. The best way is to dip them in quite boiling water for a minute or less, then to lay them between a few sheets of drying paper with slight pressure, merely to remove the exterior moisture, and then place them (when externally dry) in the drying press. Plants collected in rain should be treated in a similar way to remove outer moisture before it is attempted to dry them.

4. When once dry, plants may be packed away between paper of almost any kind. Old newspapers answer very well. The only precaution needed is to preserve them from insects.

The chief trouble in collecting plants is to get the paper already used thoroughly dry before it is again employed. The best resource in dry climates is to stretch cords and hang these papers exposed to sun and air. Artificial heat must be resorted to in wet seasons, but the process is then slow and troublesome.

For a traveller wishing to make large collections, the time consumed in changing the paper in which the plants are dried becomes an important consideration. I have adopted with advantage a suggestion of the late Professor A. Gray to use, instead of ordinary drying paper, sheets cut to the proper size, of the paper-felt which is used for laying under carpets. The specimens when originally laid out for drying are placed within sheets of thin paper without size, such as filtering paper, and as a rule these do not need to be changed. One sheet of felt-paper is generally sufficient between each layer of plants, and the operation of changing the paper is very quickly effected.

It is an important rule to note *the locality* where the specimens have been collected, *with the date*. If proper care be taken to keep together all the specimens collected at the same time, it is not necessary to place a separate scrap of paper within each sheet; but it is advisable to do this when the dried specimens are packed for transmission home.

5. *Seeds*.—Travellers may easily make valuable contributions to our knowledge of the vegetation of distant countries by preserving seeds of remarkable and unusual plants. The only precautions necessary are, to select seeds that are fully ripe; if enclosed in a seed vessel, or covering of a succulent character, to take care that this is thoroughly dried before they are packed; and that they are preserved from moisture during the homeward voyage. Small seeds may be enclosed in paper, the larger kinds in canvas bags, and the whole wrapped in a piece of oiled cloth.

It is very desirable to keep each description of seed separate, and to note the place where it was gathered, with indications of altitude, soil, and climate.

6. *Bulbs*.—These are easily obtained, but as a rule, they should be taken only at the end of the growing season, and kept until the leaves are quite withered. They should be packed dry in a small box with shavings, or other elastic stuffing. The same treatment will suit the pseudo-bulbs of some orchids.

7. *Fleshy Tubers*.—Fleshy and thick tubers are best sent in boxes, wrapped in slightly moist materials, such as cocoa-nut fibre, peat, or leaf mould.

8. *Living Plants*.—As a general rule, these require to be established in pots or boxes for some time before being packed for transmission. They travel best in what are called Wardian cases; but an ordinary wooden box covered with a glass top, and with sufficient moisture in the soil and air to prevent excessive evaporation, is found to answer the purpose. The cases should be kept on deck under some protection from the direct heat of the sun. Tropical plants should be despatched so as to reach England during the summer months. At other seasons they are liable to perish from cold.

9. *Succulent Plants*, such as cacti, aloe, houseleeks, &c., survive for a long time if packed without earth in a perfectly dry box, with sufficient openings for ventilation.

10. Small plants with woody roots and cuttings of larger species of plants from the north or south temperate zones often travel successfully when merely packed with a little soil, slightly moist, about the roots, and a wrapping of damp moss, or similar substance, tied up in thick paper or canvas. There is, however, much risk of failure in these cases where, on the homeward voyage, it is necessary to pass through the tropics.

As a general rule, plants are more often injured by excess of moisture than by being sent too dry.

It is desirable to make use of every favourable opportunity for sending botanical collections of all kinds to England, as in hot countries they are always exposed to risk of injury.

It is scarcely necessary to mention that living plants, as well as seeds, and bulbs, should be placed in the hands of skilful gardeners after reaching this country. The chance of preserving interesting specimens

is commonly much greater when they are sent to botanic gardens than when entrusted to private cultivators. In all cases information as to the soil and climate of the native home of the plant is a necessary guide to proper treatment.

Fossils.—The collection of fossils and minerals (except in the case of the discovery of new localities for valuable metals) is not to be recommended to the traveller, if he is not a geologist. Fossils from an unexplored country are of little use unless the nature and order of superposition of the strata in which they are found can be at the same time investigated. In the cases, however, of recent alluvial strata or the supposed beds of ancient lakes, or deposits in caves, or raised sea-beaches containing shells or bones of vertebrate animals, the traveller will do well to bring away specimens if a good opportunity offers. If the plan of the expedition includes the collection of fossil remains, the traveller will, of course, provide himself with a proper geological outfit, and obtain the necessary instructions before leaving Europe. (See Section III.) For suggestions as to the collecting and preserving fossils and minerals, cf. British Museum 'Handbook,' pp. 128-135.

General Remarks.—All collections made in tropical countries should be sent to Europe with the least possible delay, as they soon become deteriorated and spoilt unless great care be bestowed upon them.

Observations of Habits, etc.—Travellers have excellent opportunities of observing the habits of animals in a state of nature, and these 'Hints' would be very deficient were not a few remarks made upon this subject. To know what to observe in the economy of animals is in itself an accomplishment which it would be unreasonable to expect the general traveller to possess, and without this he may bring home only insignificant details, contributing but little to our stock of real knowledge. One general rule, however, may be kept always present to the mind, and this is, that anything concerning animals which bears upon the relations of species to their conditions of life is well worth observing and recording. Thus, it is important to note the various enemies which each species has to contend with, not only at one epoch in its life, but at every stage from birth to death, and at different seasons and in different localities. The way in which the existence of enemies limits the range of a species should also be noticed. The inorganic influences which inimically affect species, especially intermittently (such as the occurrence of disastrous seasons),

and which are likely to operate in limiting their ranges, are also important subjects of inquiry. The migrations of animals, and especially any facts about the irruption of species into districts previously uninhabited by them, are well worth recording. The food of each species should be noticed, and if any change of customary food is observed, owing to the failure of the supply, it should be carefully recorded. The use in nature of any peculiar physical conformation of animals, the object of ornamentation, and so forth, should also be investigated whenever opportunity occurs. Any facts relating to the interbreeding in a state of nature of allied varieties, or the converse—that is, the antipathy to intercrossing of allied varieties—would be extremely interesting. In short, the traveller should bear in mind that facts having a philosophical bearing are much more important than mere anecdotes about animals.

To observe the actions of the larger animals, a telescope or field-glass will be necessary. The traveller should bear in mind, if a microscope is needed in his journey, that by unscrewing the tubes of the telescope in which all the small glasses are contained, a compound microscope of considerable power may be produced.

V. ANTHROPOLOGY.

By the late SIR E. B. TYLOR, D.C.L., F.R.S.

THE characters of men's bodies and minds being matters of common observation, Europeans not specially trained in anthropology, who have happened to be thrown among little-known tribes, often bring home valuable anthropological information. Though explorers, traders, and colonists have made their way into almost every corner of the earth, it is surprising to find how many new facts may still be noted down by any careful observer. If familiar with anthropological methods, he will, of course, observe more and better. The hints here given will serve to draw attention to interesting points which might otherwise be overlooked. Directions for such investigation, drawn up in much greater detail, will be found in the small British Association manual entitled: 'Notes and Queries on Anthropology' (Royal Anthropological Institute, 50, Great Russell Street, W., 4th edition (1912), price 5s. For fuller details see the international agreement for the Unification of Anthropometric Measurements to be made on the living subject. English translation of the official version, W. L. H. Duckworth.

Physical Characters.—On first coming among an unfamiliar race, such as the Negroes, the traveller is apt to think them almost alike, till after a few days he learns to distinguish individuals more sharply. This first impression, however, has a value of its own, for what he vaguely perceived was the general type of the race, which he may afterwards gain a more perfect idea of by careful comparison. Among tribes who for many generations have led a simple uniform life and mixed little with strangers, the general likeness of build and feature is very close, as may be seen in a photograph of a party of Caribs or Andamaners, whose uniformity contrasts instructively with the individualised faces of a party of Europeans. The consequence is that a traveller among a rude people, if he has something of the artist's faculty of judging form, may select.

groups for photography which will fairly represent the type of a whole tribe or nation. While such portrait-groups are admirable for giving the general idea of a race, characteristic features belonging to it should be treated separately. For instance, to do justice to the Tartar eye or the Australian forehead, the individual feature must be carefully sketched or photographed large.

How deceptive mere unmeasured impressions of size may be is shown by the well-known example of the Patagonians, who, though really only tall men (averaging 5 feet 11 inches), long had the reputation of a race of giants. Such measurements as any traveller can take with a measuring-tape and a three-foot rule with sliding square are good if taken with proper precautions. As the object of the anthropologist is to get a general idea of a race, it may be in some respects misleading to measure at random one or two individuals who are perhaps not fair specimens. If only a few can be measured, they should be selected of ordinary average build, full-grown but not aged. What is much better is to measure a large number (never less than thirty) of persons taken indiscriminately as they come, and to record the measurements of each with sex, age, name, locality, etc. Such a table can afterwards be so classified as to show not only the average or mean size, but the proportion of persons who vary more or less from that mean size; in fact, it represents on a small scale the distribution of stature, etc., in the whole people. Gigantic or dwarfish individuals, if not deformed, are interesting, as showing to what extremes the race may run. The most ordinary measurements are height, girth round chest, fathom or length of outstretched arms, length of arm from shoulder and leg from hip, length of hand and foot. The traveller may find that such measuring of another race shows very different stature and girth from that of his own companions, who, if they are well-grown Europeans, may stand 5 feet 8 inches to 6 feet, and measure 34 to 36 inches round the chest. Beyond this, he will find that the relative proportions of parts of the body differ from those he is accustomed to. An example of this is seen by placing Europeans and negroes side by side, and noticing how much nearer the knee the negro's finger-tips will reach. It will be found that body measurement needs skill in taking the corresponding points, and in fact all but the simplest measures require some knowledge of anatomy. This is especially the case with skull measurements. There are instruments for taking the dimensions of the living

head, and with care and practice the untrained observer may get at some of the more conspicuous, such as the relative length and width of the skull as taken by hatters. This roughly indicates the marked difference between dolichocephalic or long-headed peoples, like the African negro, and brachycephalic or short-headed peoples, like the Kalnuks and other Tartars. Attention should be paid also to the degree of prognathism or projection of jaw, which in some races, as the Australian, gives a "muzzle" unlike the English type. Where practicable, native skeletons, and especially skulls, should be sent home for accurate examination. How far this can be done depends much on the feeling of the people; for while some tribes do not object to the removal of bones, especially if not of their own kinsfolk, in other districts it is hardly safe to risk the displeasure of the natives at the removal of the dead—a feeling which is not only due to affection or respect, but even more to terror of the vengeance of the ghosts whose relics have been disturbed.

In describing complexion, such terms as "brown" or "olive," so often used without further definition in books of travel, are too inexact to be of use. Broca's scale of colours (*see* Final Report of British Association Committee on Anthropometric Method. R. Anthropol. Institute, 1909) gives means of matching the tints of skin, hair and eyes; if this is not forthcoming, the paint-box should be used to record them. Among rude tribes, the colour of the skin is often so masked by paint and dirt that the subject must be washed to see the real complexion. Hair is also an important race-mark, varying as it does in colour from flaxen to black, and also in form and size of the hairs; for instance the American Indian's coarse straight hair seems almost like a horse's tail in comparison with the Bushman's hair with its natural frizz of tiny spirals. Locks of hair should therefore be collected. The traveller, however, will often find some difficulty in getting such specimens, from the objection prevalent in the uncivilised world of letting any part of the body, such as hair and nail-clippings, pass into strangers' hands lest they should be used to bewitch their former owner. Even in such countries as Italy, to ask for a lock of a peasant-girl's hair may lead to the anthropologist being suspected of wishing to practise love-charms on her.

Differences of temperament between nations are commonly to be noticed; for instance, in comparing the shy and grave Malays with the boisterous Africans. It is an interesting but difficult problem how far

such differences are due to inherited race-character, and how far to such social influences as education and custom, and to the conditions of life being cheerful or depressing. Nor has it yet been determined how far emotions are differently expressed by different races, so that it is worth while to notice particularly if their smiling, laughing, frowning, weeping, blushing, etc., differ perceptibly from ours. The acuteness of the senses of sight, hearing and smell, among wild peoples is often remarkable, but this subject is one on which many accounts have been given which require sifting. The skill of savages in path-finding and tracking depends in great measure on this being one of their most necessary arts of life to which they are trained from childhood, as, in an inferior degree, gipsies are with us. The native hunter or guide's methods of following the track of an animal, or finding his own way home by slight signs, such as bent twigs, and keeping general direction through the forest by the sky and the sheltered sides of the trees, are very interesting, though when learnt they lose much of their marvellous appearance. The testing of the mental powers of various races is an interesting research, for which good opportunities now and then occur. It is established that some races are inferior to others in volume and complexity of brain, Australians and Africans being in this respect below Europeans, and the question is to determine what differences of mind may correspond. Setting aside the contemptuous notions of uneducated Europeans as to the minds of "black-fellows" or "niggers," what is required is, to compare the capacity of two races under similar circumstances. This is made difficult by the fact of different training. For instance, it would not be fair to compare the European sportsman's skill in woodcraft and hunting with that of the native hunter, who has done nothing else since childhood; while, on the other hand, the European, who has always lived among civilised people, owes to his education so much of his superior reasoning powers, that it is mostly impossible to get his mind into comparison with a savage's. One of the best tests is the progress made by native and European children in colonial or missionary schools, as to which it is commonly stated that children of African or American tribes learn as fast as or faster than European children up to about twelve, but then fall behind. Even here it is evident that other causes besides mental power may be at work, among them the discouragement of the native children when they become aware of their social inferiority. The subject is one

of great importance, both scientifically and as bearing on practical government.

Both as a matter of anthropology and of practical politics the suitability of particular races to particular climates is of great interest; sometimes this depends on one race being free from a disease from which another suffers, as in the well-known immunity of negroes from yellow fever. Or it may be evident that tribes have become acclimatised, so as to resist influences which are deadly to strangers; for instance, the Khonds flourish in the hills of Orissa, where not only Europeans but the Hindus of the plains sicken of the malaria in the unhealthy season. That such peculiarities of constitution are inherited and pass into the nature of the race, is one of the keys to the obscure problem of the origins of the various races of man as connected with their spread over the globe. As yet this problem has not passed much beyond the stage of collecting information, and no pains should be spared to get at facts thus bearing on the history and development of the human species. European medical men in districts inhabited by uncivilised races have often made important observations of this kind, which they are glad to communicate, though being occupied with professional work they do not follow them up. In all races there occur abnormal varieties, which should be observed with reference to their being hereditary, such as Albinos, whose dead-whiteness is due to absence of pigment from the skin. Even such tendencies as that to the occurrence of red hair where the ordinary hue is black, or to melanism or diseased darkening of the skin, are worth remark. It is essential to discover how far these descend from parents to children, which is not the case with such alterations as that of the Chinese feet, which, in spite of generations of cramping, continue of the natural shape in the children.

Language.—Before coming to actual language, remark may be made on the natural communication of all races carried on by pantomimic signs without spoken words. This is the "gesture language" to which we are accustomed among the deaf-and-dumb, and which sometimes also comes into practical use between tribes ignorant of one another's languages, as on the American prairies. It is so far the same in principle everywhere, that the explorer visiting a new tribe, having to make frequent use of signs to supplement his interpreter, or to eke out his own scanty knowledge of the native language, soon adapts himself to the particular signs

in vogue. He will observe that, as to most common signs, such as asking for food or drink, or beckoning or warning off a stranger, he understands and is understood quite naturally. Signs which are puzzling at first sight will prove on examination to be intelligible. Some are imitative gestures cut short to save trouble, or they may have a meaning which was once evident, like the American Indian sign for dog, made by trailing two forked fingers, which does not show its meaning now, but did so in past times, when one of the principal occupations of the dog was to trail a pair of tent-poles attached to his back. Besides its practical use, the gesture-language has much scientific interest from the perfect way in which it exposes the working of the human mind, expressing itself by a series of steps which are all intelligible. It will be particularly observed that it has a strict syntax; for instance, that the quality or adjective must always follow the subject or substantive it is applied to. Thus, "the white box" may be expressed by imitating the shape and opening of a box, and then touching a piece of linen or paper to show its colour; but if the signs be put in the contrary order, as in the English words, the native will be perplexed. It is worth while, in countries where gesture-language is regularly used, to note down the usual signs and their exact order.

In recording a vocabulary of a language not yet reduced to form in a grammar and dictionary, the traveller may seek for equivalents of the principal classes of words in his own grammar: verbs, substantives, adjectives, pronouns, prepositions, etc. But the structure of the language he is examining will probably differ from any he is familiar with, the words actually used not coming precisely into these classes. The best method is for the traveller to learn a simple sentence, such as "the men are coming," and to ascertain what changes will convert them into "the men are going," "the women are coming." He thus arrives at the real elements of the language and the method of combining them. Having arrived at this point, he will be able to collect and classify current ideas, such as the following:—

Actions—as stand, walk, sleep, eat, see, make, etc.

Natural Objects and Elements—as sun, moon, star, mountain, river, fire, water, etc.

Man and other Animals—as man, woman, boy, girl, deer, buck, doe, eagle, eagles, etc.

Parts of Body—as head, arm, leg, skin, bone, blood, etc.

Trees and Plants.

Numerals (noticing how far they extend, and whether referring to fingers).

Instruments and Appliances—as spear, bow, hatchot, needle, pot, boat, cord, house, roof, &c.

Arts and Pastimes—as picture, paint, carving, statue, song, dance, toy, game, riddle, &c.

Family Relationships (as defined by native custom).

Social and Legal Terms—as chief, freeman, slave, witness, punishment, fine, &c.

Religious Terms—as soul, spirit, dream, vision, sacrifice, penance, &c.

Moral Terms—as truth, falsehood, kindness, treachery, love, &c.

Abstract Terms, relating to time, space, colour, shape, power, cause, &c.

The interjections used in any language can be noted, whether they are organic expressions of emotion, like *oh! ugh! ur-r-r!* or sounds the nature of which is not so evident. Also imitative words which name animals from their cries, or express sounding objects or actions by their sounds, are common in all languages, and strike the stranger. Examples of such are *kah-kah* for a crow, *twonk* for a frog, *pututu* for a shell-trumpet, *haischu* for to sneeze. When such imitative words are noticed passing into other meanings where the connection with sound is not obvious, they become interesting facts in the development of language; as, to take a familiar example from English, the imitative verb to *puff* becomes a term for light pastry and metaphorically blown-up praise.

It is only when the traveller has a long or close acquaintance with a tribe, that he is able to deal satisfactorily with the vocabulary and structure of their language. To be able to carry on a conversation in broken sentences is not enough, for an actual grammar and dictionary is required to enable philologists to make out the structure and affinities with other languages. It used to be customary to send out English lists of thirty or forty ordinary words to have equivalents put to them in native languages. As every detail of this kind is worth having, these lists cannot be said to be quite worthless, but they go hardly any way toward what is really wanted. They are liable to frequent mistakes, as when the barbarian, from whom the white man is trying to get the term "foot," answers with a word meaning "my leg," which is carefully taken

down and printed. Such poor vocabularies cannot even be relied on to show whether a language belongs to a particular family, for the very word which seems to prove this may be borrowed. Thus, in various African vocabularies, there appears the word *sapun* (or something similar) with the meaning of *soap*; but this is a Latin word which has spread far and wide from one country to another, and proves nothing as to original connection between languages which have adopted it. While it is best not to under-rate the difficulty of collecting such information as to a little-known dialect as will be really of service to philology, it must be remembered that travellers still often have opportunities of preserving relics of languages, or at any rate special dialects, which are on the point of dying out unrecorded. Where no proper grammar and dictionary has been compiled, it is often possible to find some European or some interpreter fairly conversant with the language, with whose aid a vocabulary may be written out and sentences analysed grammatically; which, when read over to intelligent natives and criticised by them, may be worked into good linguistic material. It is worth while to pay attention to native names of plants, minerals, &c., as well as of places and persons, for these are often terms carrying significant meaning. Thus *ipêcacuanha* is stated by Martius to be *i-pe-cao-guêno*, which in the Tupi language of Brazil, signifies "the little wayside plant which makes vomit."

Arts and Sciences.—The less civilised a nation is, the ruder are its tools and contrivances; but these are often worked with curious skill in getting excellent results with the roughest means. Stone implements have now been so supplanted by iron that they are not easily found in actual use. If a chance of seeing them occurs, as, for instance, among some Californian tribe, who still chip out arrow-heads of obsidian, it is well to get a lesson in the curious and difficult art of stone-implement making. In general, tools and implements differing from those of the civilised world, even down to the pointed stick for root-digging and planting, are worth collecting, and to learn their use from a skilled hand often brings into view remarkable peculiarities. This is the case with many cudgel or boomerang-like weapons thrown at game, slings or spear-throwers for hurling darts to greater distances than they can be sent by hand, blow-tubes for killing birds, and even the bow-and-arrow, which in northern Asia and America shows the ancient Scythian or Tartar form, having to be bent inside out to string it. Though fire is now practically

made almost everywhere with flint and steel or lucifers, in some districts, as South Africa or Polynesia, people still know the primitive method of fire-making by rubbing or drilling a pointed stick into another piece of wood. Europeans find difficulty in learning this old art, which requires some knack. As is well known to sportsmen, different districts have their special devices for netting, trapping and other ways of taking game and fish, some of which are well worth notice, such as spearing or shooting fish under water, artificial decoys, and the spring-traps set with bent boughs, which are supposed to have first suggested the idea of the bow. While the use of dogs in hunting is found in most parts of the world, there is the utmost variety of breeds and training. Agriculture in its lower stages is carried on by simple processes; but interesting questions arise as to the origin of its grain and fruits, and the alterations in them by transplanting into a new climate and by ages of cultivation. Thus in Chili there is found wild what botanists consider the original potato; but while maize was a staple of both Americas at the time of Columbus, its original form has no more been identified than that of wheat in the Old World. The cookery of all nations is in principle known to the civilised European; but there are special preparations to notice, such as bucaning or drying meat on a hurdle above a slow fire, broiling kebabs or morsels of meat on the skewer in the East, etc. Many peoples have something peculiar in the way of beverages, such as the chewed Polynesian *kava*, or the South American *mate* sucked through a tube. Especially fermented liquors have great variety, such as the *kumiss* from mares' milk in Tartary, the *pombe* or millet-beer of Africa, and the *kvass* or rye-beer of Russia. The rudest pottery made by hand, not thrown on the wheel, is less and less often met with, but ornamentation traceable to its being moulded on baskets is to be seen; and calabashes, joints of bamboo, and close-plaited baskets are used for water-vessels, and even to boil in. Among the curious processes of metal-working, contrasting with those of modern Europe, though often showing skill of their own, may be mentioned the simple African smelting-forge by which iron-ore is reduced with charcoal in a hole in the ground, the draught being supplied by a pair of skins for bellows. In the far East a kind of air-pump is used, of which the barrels are hollowed logs. The Chinese art of patching cast-iron with melted metal surprises a European, and the Hindu manufacture of native steel (*woots*) is a remarkable process. No

nation now exists absolutely in the Bronze Age, but this alloy still occupies something of its old place in Oriental industry. As an example of the methods still to be seen, may be mentioned the Burmese bell-founding, which is done, not in a hollow mould of sand, but by what in Europe is called the *cire perdue* process, the model of the bell being made in bees-wax and imbedded in the sand-mould, the wax being melted and the hot metal taking its place. The whole history of machinery is open to the traveller, who still meets with every stage of its development, from savagery upward. He sees, for instance, every tilling implement from the stake with fire-hardened point, and the hoe of crooked branch, up to the modern forms of plough. In like manner he can trace the line from the rudest stone-crushers or rubbers for grinding seed or grain up to the rotating hand-mills or querns still common in the East, and surviving even in Scotland. From time to time some special contrivance may be seen near its original home, as in South America the curious plaited tube for wringing out the juice from cassava, or the net hammock which still retains its native Haitian name *hamaca*. Architecture still preserves in different regions interesting early stages of development, from the rudest breakwinds, or beehive huts of wattled boughs, up to houses of logs and hewn timber, structures of mud and adobes, and masonry of rough or hewn stone. Even the construction of the bough-hut or the log-house often has its peculiarities in the arrangements of posts and rafters. Among the modes of construction which interest the student of architectural history is building with rough unhewn stones. Many examples of "rude stone monuments" are to be seen on our own moors and hills. The most familiar kinds are *dolmens* (i.e., "table-stones"), formed by upright stones bearing a cap-stone; they were burial-places, and analogous to the cists or chambers of rough slabs within burial-mounds. Less clearly explicable are the single standing-stones or *menhirs* (i.e., "long-stones"), and the circles of stones or *cromlechs*. Ancient and obscure in meaning as such monuments are in Europe, there are regions where their construction or use comes down to modern times, especially in India, where among certain tribes the deposit of ashes of the dead in dolmens, the erection of menhirs in memory of great men, and even sacrifice in stone circles, are well-known customs. The traveller may also sometimes have opportunities of observing the ancient architectural construction by fitting together many-sided stones into what are some-

times called Cyclopean walls, a kind of building which seems to have preceded the use of squared blocks, fastened together with clamps or with mortar. Vaulting or roofing by means of courses of stones projecting inwards one course above the other (much as children build with their wooden bricks), so as to form what architects call a "false arch," is an ancient mode of construction found in various parts of the world where the "true arch" with its keystone has not superseded it. It often appears that rude nations have copied the more artistic buildings of higher neighbours, or inherited ancient architectural traditions. Thus traces of Indian architecture have found their way into the islands of the Eastern Archipelago, and hollow squares of mud-built houses round a courtyard in northern Africa have their plan from the Asiatic caravan-serai. In boat-building some primitive forms, as the "dug-out," hollowed by the aid of fire from a tree-trunk, and the bark-canoe, are found in such distant regions that we cannot guess where they had their origin. When, however, it comes to the outrigger-canoe, this belongs to a district which, though very large, is still limited, so that we may at least guess whereabouts it first came into use, and it is important to note every island to which it has since travelled. So there is much in the peculiar build and rig of Malay prahus, Chinese junks, etc., which is worth noting as part of the history of ship-building. This may suffice to give a general idea of the kind of information as to the local arts which it is worth while to collect, and to illustrate by drawings and photographs of objects too large to bring away.

Naturally, nations below the upper levels of culture have little or no science to teach us, but many of their ideas are interesting as marking stages in the history of the human mind. Thus, in the art of counting, which is one of the foundations of science, it is common to find the primitive method of counting by fingers and toes still in practical use, while in many languages the numeral words have evidently grown up out of such a state of things. Thus *lima*, the well-known Polynesian word for five, meant "hand," before it passed into a numeral. All devices for counting are worth notice, from the African little sticks for units and larger sticks for tens, up to the ball-frames with which the Chinese and Russian traders reckon so rapidly and correctly. It is a sign of lowness in a tribe not to use measures and weights, and where these appear in a rough way, it is interesting to discover whether vague lengths, such as

finger, foot, pace, are used, or whether standard measures and weights have come in. If so, these should be estimated according to our standards with as much accuracy as possible, as it may thus become possible to ascertain their history. In connection with this comes the question of money, as to whether commerce is still in the rudimentary stage of exchanging gifts, or has passed into regular barter, or risen to regular trade, with some sort of money to represent value, even if the circulating medium be only cowries, or bits of iron, or cakes of salt, all which are current money to this day in parts of Africa. Outside the present higher civilisation, more or less primitive ideas of astronomy and geography will be found to prevail. Among tribes like the American Indians the obvious view suggested by the senses still prevails, that the earth is a flat round disc (or sometimes square, with four quarters or winds) overarched by a solid dome or firmament, on which the sun and moon travel—in inland countries going in and out at holes or doors on the horizon, or, if the sea bounds the view, rising from and plunging into its waves at sunrise and sunset. These early notions are to us very instructive, as they enable us to realise the conceptions of the universe which have come down to us in the ancient books of the world, but which scientific education has uprooted from our own minds. With these cosmic ideas are found among the lowest races the two natural periods of time, namely, the lunar month and the solar year, determined by recurring winters, summers, or rainy seasons. Such tribes divide the day roughly by the sun's height in the sky, but among peoples civilised enough to have time-measures and the sun-dial, there is a tolerably accurate knowledge of the sun's place at the longest and shortest days, and indeed, throughout the year. The astronomy of such countries as India has been of course described by professional astronomers; but among ruder nations there is still a great deal unrecorded—for instance, as to the constellations into which they map out the heavens. This likening stars and star-groups to animals and other objects is almost universal among mankind. Savages like the Australians still make fanciful stories about them, as that Castor and Pollux are two native hunters, who pursue the kangaroo (Capella) and kill him at the beginning of the hot season. Such stories enable us to understand the myths of the Classical Dictionary, while modern astronomers keep up the old constellations as a convenient mode of mapping out the sky. As to maps of the earth, even low tribes have some notion of their principle,

and can roughly draw the chart of their own district, which they should be encouraged to do. Native knowledge of natural history differs from much of their rude science in its quality, often being of great positive value. The savage or barbarian hunter knows the animals of his own region and their habits with remarkable accuracy, and inherited experience has taught him that certain plants have industrial and medicinal uses. Thus, in South America the Europeans learnt the use of India-rubber or caoutchouc, which the native tribes were accustomed to make into vessels and playing-balls, and of the Peruvian bark or cinchona, which was already given to patients in fever.

Here a few words may be said of magic, which, though so utterly futile in practice, is a sort of early and unsuccessful attempt at science. It is easy, on looking into the proceedings of the magician, to see that many of them are merely attempts to work by false analogy or deceptive association of ideas. The attempt to hurt or kill a person by cutting or piercing a rude picture or image representing him, which is met with in all the four quarters of the globe, is a perfect example of the way in which sorcerers mistake mere association of ideas for real cause and effect. Examined from this point of view, it will be found that a large proportion of the magic rites of the world will explain their own meaning. It is true that this is not the only principle at work in the magician's mind; for instance, he seems to reason in a loose way that any extraordinary thing will produce any extraordinary effect, so that the peculiar stones and bits of wood which we should call curiosities become to the African sorcerer powerful fetishes. It will often be noticed that arts belonging to the systematic magic of the civilised world, which has its source in Babylon and Egypt, have found their way into distant lands more readily indeed than useful knowledge, so that they may even be met with among barbaric tribes. Thus it has lately been pointed out that the system of lucky and unlucky days, which led the natives in Madagascar to kill many infants as of inauspicious birth, is adopted from Arabic magic, and it is to be expected that many other magical arts, if their formulas are accurately described, may in like manner be traced to their origin.

Society.—One of the most interesting features of savage and barbaric life is the existence of an unwritten code of moral conduct, by which families and tribes are practically held together. There may be no laws

to punish crime, and the local religion may no more concern itself directly with men's behaviour to one another than it did in the South Sea Islands. But among the roughest people there is family affection, and some degree of mutual help and trust, without which, indeed, it is obvious that society would break up, perhaps in general slaughter. Considering the importance of this primitive morality in the history of mankind, it is unfortunate that the attention of travellers has been so little drawn to it, that our information is most meagre as to how far family affection among rude tribes may be taken to be instinctive, like that of the lower animals, or how far morality is produced by public opinion favouring such conduct as is for the public good, but blaming acts which do harm to the tribe. It is desirable to inquire what conduct is sanctioned by custom among any people, whether, for instance, infanticide is thought right or wrong, what freedom of behaviour is approved in youths and girls, and so on. For though breaches of custom may not be actually punishable, experience will soon convince any explorer among any rude tribe that custom acts in regulating their life even more strictly than among ourselves. The notion of even savages leading a free and unrestrained life is contradicted by those who know them best; in fact, they are bound in every act by ancestral custom. While each tribe thus has its moral standard of right and wrong, this differs much in different tribes, and one must become intimately acquainted with any people to ascertain what are really their ruling principles of life. Accounts have been often given of the natural virtue and happiness of rude tribes, as in the forests of Guiana or the hills of Bengal, where the simple native life is marked by truthfulness, honesty, cheerfulness, and kindness, which contrast in a striking way with the habits of low-class Europeans. There are few phenomena in the world more instructive than morality thus existing in practical independence either of law or religion. It may still be possible to observe it for a few years before it is altered by contact with civilisation, which, whether it raises or lowers on the whole the native level, must supersede in great measure this simple family morality.

The unit of social life is the family, and the family is based on a marriage-law. Travellers who have not looked carefully into the social rules of tribes they were describing, or whose experience has been of tribes in a state of decay, have sometimes reported that marriage hardly existed. But this state of things is not confirmed as descriptive of any

healthy human society, however rude; in fact, the absence of definite marriage appears incompatible with the continued existence of a tribe. Therefore statements of this kind made by former visitors should be carefully sifted, and marriage-laws in general deserve careful study. The explorer will hardly meet with marriage at so low a stage that the union can be described as little beyond annual pairing; but where divorce is almost unrestricted, as in some African tribes, there is more or less approach to this condition, which is possible, though unusual, under such laws as that of Islam. Polygamy, which exists over a large part of the globe, is a well-understood system, but information is less complete as to the reasons which have here and there led to its opposite polyandry, as among the Toda hill-tribes and the Nairs in South India. Among customs deserving inquiry are match-making festivals at spring-tide or harvest, when a great part of the year's marriages are arranged. This is not only often done among the lower races, but traces of it remain in Greece, where the dances at Megara on Easter Tuesday are renowned for wife-choosing, and till lately in Brittany, where on Michaelmas Day the girls sate in a row decked in all their finery on the bridge of Penzé, near Morlaix. The custom of bride-capture, where the bridegroom and his friends make show of carrying off the bride by violence, is known in Europe as a relic of antiquity, as in ancient Rome, Wales within the last century or two, or Tyrol at the present day; but in more barbaric regions, as on the Malay peninsula or among the Kalmuks of North Asia, it may be often met with, practised as a ceremony, or even done in earnest. On the other hand, restrictions on marriage between kinsfolk or clansfolk are more prominent among the lower races than in the civilised world, but their motive is even now imperfectly understood. Partly these restrictions take the form we are accustomed to of prohibiting marriage between relatives more or less near in our sense, but among nations at a lower level they are apt to involve also what is called exogamy or "marrying-out." A tribe or people—for instance, the Kamilaroi of Australia, or the Iroquois of North America—is divided into hereditary clans, members of which may not marry in their own clan. In various parts of the world these clans are named from some animal, plant, or other object, and anthropologists often call such names "totems," this word being taken from the native name among Algonquin tribes of North America. For an instance of the working of this custom among the Iroquois tribes

a Wolf was considered brother to a Wolf of any other tribe, and might not marry a Wolf girl, who was considered as his sister, but he might marry a Deer or a Heron. In contrast with such rules is the practice of endogamy, or "marrying-in," as among some Arab tribes, who habitually marry cousins. But it will be found that the two rules often go together, as where a Hindu must practically marry within his own caste, but at the same time is prohibited from marrying in his own gotra or clan. Researches into totem-laws are apt to bring the traveller into contact with other relics of the ancient social institutions in which these laws are rooted, especially the practice of reckoning descent not on the father's side, as with us, but on the mother's side, after the manner of the Lycians, whose custom seemed extraordinary to the Greeks in the time of Herodotus, but may be still seen in existence among native tribes of America or in the Malay islands. Even the system of relationship familiar to Europeans is far different from those of regions where forms of the "classificatory system" prevail, in which father's brothers and mother's sisters are called fathers and mothers. In inquiring into native laws of marriage and descent, precautions must be taken to ensure accuracy, and especially such ambiguous English words as "uncle" or "cousin" should be kept clear of.

Another point on which travellers have great opportunity of seeing with their own eyes the working of primitive society is the holding and inheritance of property, especially land. Notions derived from our modern law of landlord and tenant give place in the traveller's mind to older conceptions, among which individual property in land is hardly found. In rude society it is very generally the tribe which owns a district as common land, where all may hunt and pasture and cut fire-wood; while, when a family have built a hut, and tilled a patch of land round it, this is held in common by the family while they live there, but falls back into tribe-land if they cease to occupy it. This is further organised in what are now often called "village communities," which may be seen in operation in Russia and India, where the village fields are portioned out among the villagers. Those who have seen them can understand the many traces in England of the former prevalence of this system in "common fields," etc. There is the more practical interest in studying the working of this old-world system from the light it throws on projects of communistic division of land, which in such villages may be studied,

and its merits and defects balanced. On the one hand it assures a maintenance for all, while on the other it limits the population of a district, the more so from the obstinate resistance which the counsel of "old men" who manage a village always oppose to any improved method of tillage. Not less perfectly do the tenures existing in many countries show the various stages of landholding which arise out of military conquest. The absolute ownership of all the land by a barbaric chief or king, which may be seen in such a country as Dahome, whose subjects hold their lands on royal sufferance, is an extreme case. In the East, feudal tenures of land granted for military service still have much the same results as in mediæval Europe.

At low levels of civilisation the first dawning of criminal law may be seen in the rule of vengeance or retaliation. The person aggrieved, or his kinsfolk if he has been killed, are at once judges and executioners, and the vengeance they inflict stands in some reasonable relation to the offence committed. Not only is such vengeance the great means of keeping order among such rude tribes as the Australians, but even among half-civilised nations like Abyssinians and Afghans the primitive law may still be studied in force, carried out in strict legal order as a *lex talionis*, not degraded to mere illegal survival in outlying districts like the "vendetta" of modern Europe, carried on even now, in spite of criminal jurisprudence, which for ages has striven to transfer punishment from private hands to the State. Whether among savages, barbarians, or the lower civilised nations, the traveller will find everywhere matter of interesting observation in the law and its administration. The law may be still in the state of unwritten custom, and the senate or council of old men may be the judges, or the power at once of lawgiver and judge may have passed into the hands of the chief, who, as among the modern Kaffirs, may make a handsome revenue by the cattle given him as fees by both sides, a fact interesting as illustrating the times when an European judge took gifts as a matter of course. Among the nations at higher levels of culture in the East, for instance, most of the stages may still be seen through which the administration of law, criminal and civil, was given over to a trained legal class. One important stage in history is marked by religion taking to itself legal control over the conduct of a nation. The working of this is seen among Oriental nations, whether Mohammedan, Brahman, or Buddhist, whose codes of law are of an ecclesiastical type, and the

lawyers theologians. There is much to be learnt from the manner in which such law is administered, and the devices are interesting by which codes framed under past conditions of society are practically accommodated to a new order of things, without professedly violating laws held to be sacred, and therefore unchangeable. Ordeals, which have now disappeared from legal procedure among European nations, are often to be met with elsewhere. Thus in Arabia the ordeal by touching or licking hot iron is still known (the latter is an easy and harmless trick, if the iron is quite white-hot). In Burma, under native rule, the ancient trial of witches by "swimming" went on till lately. In many countries also symbolic oaths invoking evils on the perjurer are to be met with, as when the Ostyaks in Siberia swear in court by laying their hand on a bear's head, meaning that a bear will kill them if they lie. It shows the carelessness with which Europeans are apt to regard the customs of other nations, that in English courts a Chinese is called upon to swear by breaking a saucer, under the entirely erroneous belief that this symbolic curse is a Chinese judicial oath.

The most undeveloped forms of government are only to be met with in a few outlying regions, as among some of the lower Esquimaux or Rocky Mountain tribes, where life goes on with hardly any rule beyond such control as the strong man may have over his own household. Much oftener travellers have opportunity of studying, in a more or less crude state, the types of government which prevail in higher culture. It is of especial interest to see men of the whole tribe gathered in assembly (the primitive *agora*) to decide some question of war or migration. Not less instructive are the proceedings of the council of old men (the primitive *senate*), who, among American tribes or the hill tribes of India, transact the business of the tribe; they are represented at a later social stage by the village-elders of the Hindus or the Russians. Among the problems which present themselves among nations below the civilised level is that of the working of the patriarchal system, still prevailing among such tribes as the Bedaween, while often the balance of power is soon adjusting itself between the patriarchal heads of families and the leaders who obtain authority by success in war. The struggle between the hereditary chief or king and the military despot, who not only usurps his place but seeks to establish hereditary monarchy in his own line, is one met with from low to high levels of national life. The traveller's attention may be

called to the social forces which do their work independently of men in authority, and make society possible, even when there is little visible authority at all. The machinery of government described in books is often much less really powerful than public opinion, which controls men's conduct in ways which are so much less conspicuous that they have hardly yet been investigated with the care they deserve.

Religion and Mythology.—While great religions, like Mohammedanism and Buddhism, have been so carefully examined that European students often know more about their sacred books than the believers themselves, yet the general investigation of the religions of the world is very imperfect, and every effort should be made to save the details from being lost as one tribe after another disappears, or passes into a new belief. Missionaries have done much in recording particulars of native religions, and some have had the skill to describe them scientifically; but the point of view of the missionary engaged in conversion to another faith is unfavourable for seeing the reasons of the beliefs and practices he is striving to upset. The object of the anthropologist is neither to attack nor defend the doctrines of the religion he is examining, but to trace their rational origin and development. It is not only among the rudest tribes that religious ideas which seem of a primitive order may be met with, but these hold their place also among the higher nations who profess a "book-religion." Thus the English or German peasant retains many ideas belonging to the ancestral religion of Thor and Woden, and the modern Burmese, though a Buddhist, carries on much of the old worship of the spirits of the house and the forest, which belong to a far earlier religious stratum than Buddhism. It is in many districts possible for the traveller to obtain at first hand interesting information as to the philosophical ideas which underlie all religions. All over the world, people may be met with whose conception of soul or spirit is that belonging to primitive animism, namely, that the life or soul of men, beasts, or things, resides in the phantoms of them seen in dreams and visions. A traveller in British Guiana had serious trouble with one of his Arawaks, who, having dreamt that another had spoken impudently to him, on waking up went quite naturally to his master to get the offender punished. So it is reported that our officials in Burma have considered themselves disrespectfully treated when the wife or servant of the person they have come to see has refused to wake him, the

Englishman not understanding that these people hold early animistic ideas, believing the soul to be away from the sleeper's body in a dream, so that it might not find its way back if he were disturbed. As scientific ideas of the nature of life and dreams are rapidly destroying these primitive conceptions, it is desirable to collect all information about them for its important bearing on the history of philosophy and religion. The same may be said as to the ancient theory of diseases as caused by demons, and the expulsion and exorcism of them as a means of cure, which may still be studied everywhere outside the scientific nations. Information as to religious rites is of course valuable, even when the foreign observer does not understand them, but if possible their exact meaning should be made out by some one acquainted with the language, otherwise acts may be confused which have really different senses, as where a morsel of food offered as a pious offering to an ancestral ghost may be taken for a sacrifice to appease an angry wood-demon. A people's ideas as to the meaning of their own rites may often be very wrong, but it is always worth while to hear what they think of the purpose of their prayers, sacrifices, purifications, fasts, feasts, and other religious ordinances, which even among savage tribes have been long since stereotyped into traditional systems.

Mythology is intimately mixed up with religion, which not only ascribes the events of the world to the action of spirits, demons, or gods, but everywhere individualises many of these beings under personal names, and receives as sacred tradition wonder-tales about them. Thus, to understand the religion of some tribes, we have not only to consider the rude philosophy under which such objects as heaven and earth or sun and moon are regarded as personal beings, whose souls (so to speak) are the heaven-god and earth-god, the sun-god and moon-god; but we have to go on further and collect the religious myths which have grown on to these superhuman beings. The tales which such a people tell of their origin and past history may to some extent include traditions of real events, but mostly they consist of myths, which are also worth collecting, as they often on examination disclose their origin, or part of it. This is seen, for instance, in the South Sea Island tale of the god Maui, whose death, when he plunged into the body of his great ancestress the Night, is an obvious myth of the sunset. The best advice as to native mythology is to write down all promising native stories, leaving it to future examination to

decide which are worth publishing. The native names of personages occurring in such stories should be inquired into, as they sometimes carry in themselves the explanation of the story itself, like the name of Great-Woman-Night in the Polynesian myth just referred to. Riddles are sometimes interesting, as being myths with an explanation attached, like the Greek riddle of the twelve black and twelve white horses that draw the chariot of the day. It is not too much to say that everything which a people thinks worth remembering as a popular tradition, and all the more if it is fixed in rhyme or verse, is worth notice, as likely to contain something of historical value. That it may not be historically true is beside the question, for the poetic fictions of a tribe often throw more light on their history than their recollections of petty chiefs who quarrelled fifty years ago. The myths may record some old custom or keep up some old word that has died out of ordinary talk, or the very fact of their containing a story known elsewhere in the world may give a clue to forgotten intercourse by which it was learnt.

Customs.—It remains to say a few words as to the multifarious customs which will come under the traveller's observation. It does not follow that because these may be mentioned or described in books they need not be further looked into. The fact is that accurate examination in such matters is so new, that something always remains to be made out, especially as the motives of so many customs are still obscure. The practice of artificially deforming the infant's skull into a desired shape, which is not quite forgotten even in Europe, may be noticed with respect to the question whether the form to which the child's head is bulged or flattened is the exaggeration of the natural form of an admired caste or race. If not, what can, for instance, have induced two British Columbian tribes, one to flatten their foreheads and the other to mould them up to a peak? In tattooing, an even more widespread practice, it is well to ascertain whether the pattern on the skin seems to have been originally tribe-marks or other signs or records, or whether the purpose is ornament. In South-East Asia the two motives are present at once, when a man has ornamental designs and magical charm-figures together on his body. With regard to ornaments and costumes, the keeping-up of ancient patterns for ceremonial purposes often affords curious historical hints. Thus in the Eastern Archipelago, the old-fashioned garments of bark-cloth are used in mourning by people who have long discarded them in ordinary wear.

and another case is found among some natives of South India, whose women, though they no longer put on an apron of leaves as their real ordinary garment, wear it over a cotton skirt on festival-days. Among the amusements of a people, songs are often interesting musically, and it is well to take them down, not only for the tunes, but also for the words, which sometimes throw light on old traditions and beliefs. Dancing varies from spontaneous expression of emotion to complex figures handed down by tradition and forming part of social and religious ceremony. The number of popular games in the world is smaller than would be supposed. When really attractive they may be adopted from one people to another till they make their way round the world. Any special variety, as of ball or draughts, should therefore be noticed, as it may furnish evidence of intercourse by which it may have come from some distant nation.

Though the subjects of anthropological interest are not even fully enumerated in the present chapter, some idea may have been given of the field of observation still open to travellers, not only in remote countries, but even in Europe. In taking notes, the explorer may be recommended not to be afraid of tedious minuteness, whereas the lively superficiality of popular books of travel makes them almost worthless for anthropology.*

In looking through the above remarks, written some years since, alteration has seemed hardly needful. The writer thinks, however, that it may be useful to call attention to the increased opportunities of travellers to study and obtain implements of the rudest and most ancient Stone Age. Up to a few years ago they could only have expected to find proof of the recent use among savages of stone hatchets, knives, arrowheads, etc., such as in Europe are relics of ancient tribes. These, indeed, have been known for more than a generation not to be the oldest relics of the kind, but have been called neolithic or of the New-Stone Age, to distinguish them from the far older and lower types of the mammoth period, called palæolithic or of the Old-Stone Age.

* More extended accounts of the departments of the Science of Man here noticed will be found in Tyler's 'Anthropology: an Introduction to the Study of Men and Civilisation' (Macmillan and Co., New edition, 1895).

Implements of this class, after their discovery in Europe, were soon noticed in India, and are now especially recognised as found over a great part of Africa. Of later years, in the islands of the South Pacific, stone implements of an even lower class have not only been found in the ground, but there is evidence that they had remained in use into modern times. In Tasmania it is on record from European eye-witnesses that tools made from chips of hard stone by trimming to an edge on one side, and which were grasped in the hand without any handle, were the cutting and hacking instruments of the natives into the last century, almost up to the time of their extinction. Thus apparently the oldest known phase of human life endured in this region untouched by civilisation, and travellers have the opportunity of studying its recent relics in Tasmania, while similar traces of rude Stone Age life, though not reaching up to so late a time, are making their appearance both in West Australia and New Zealand. Travellers should be careful to consider whether chipping is really artificial, and not due to natural action of water or wind-blown sand. There is no doubt that many "implements" in our museums are freaks of nature, *e.g.*, those found in such quantities in the desert plateaux above the lower Nile.

Travellers of the present day have still opportunities of observation in the history of culture which will have disappeared in another generation. Inquiry in outlying countries should be made for the vanishing survivals of arts and customs, stories, and even languages. In Europe there is much of this kind to be met with by the inquirer, especially off the beaten track. Thus the dug-out canoe, the monoxyle of Hippocrates, need not be sought on African lakes, for it is still the fisherman's craft of Hungary and Bosnia; and in the same region the apparatus for producing the ceremonial need-fire by friction of wood, which disappeared from Scotland towards the beginning of last century, and the "whithorn" of coiled bark, the rustic musical instrument just vanishing from English peasant life, are still in ceremonial use. As for savage tribes which come within the traveller's ken, though their stone implements have been mostly superseded by the white man's cutlery, many arts of the remote past may still be seen. The yet simpler means of producing fire by drilling a stick with the hands without further mechanical adaptation may still be seen among savages who have not lost their old arts, and the twisting of thread with the hands, which preceded the use of even

the spindle, is not everywhere forgotten. Though the study of the religion and folklore of the savage and barbaric world must be left to those who are residents rather than visitors, the passer-by who inquires may see primitive rites of religion or magic. Thus in many an Indian house in Arizona or New Mexico the traveller is reminded of his classic recollections when he sees the first morsel of the meal thrown into the fire as an offering to the ancestral spirits.

NOTE BY PROFESSOR R. R. MARETT.

'Although Sir Edward Tylor's summary account of the task of the field anthropologist was written many years ago, and is now reproduced in a substantially unaltered form, one can confidently recommend it as still adequate to the needs of a rapidly progressing science. The general plan of campaign, so brilliantly sketched here, remains much the same. On the other hand, the traveller in these latter days, instead of opening up fresh fields, must for the most part be content to work over old ground more carefully than his predecessors. Unless, therefore, he is prepared to discard superficial modes of observation and devote himself to a critical and intensive study of the available facts, he had much better leave the subject alone. It will help greatly if he has been through a course of special training, such as several of the leading Universities can nowadays provide.'—R. R. MARETT.

The following books will be found useful to the traveller, besides those mentioned above:—

'Handbook of Folk-lore'; published by the Folk-lore Society. Ed. C. S. Burne.

'Anthropology': Prof. R. R. Marett. Home University Library. Williams & Norgate.

QUERIES OF ANTHROPOLOGY.—By the late SIR A. W. FRANKS, K.C.B., F.R.S.

I. *Physical Character.*

Average height of men and women in each tribe. Character of hair: straight, wavy, curly, frizzy, or woolly. Prognathism. Strength in lifting and carrying weights, &c. Speed in running. Accuracy of aim. Knowledge of numbers, weights, and measures.

II. *Mode of Subsistence.*

Whether mainly by hunting, or by pastoral or agricultural pursuits.
Any instances of dwellings in caves.

Use of boats; forms of boats and of paddles; mode of paddling.

Any particular stratagems used in hunting, snares and traps; implements for hunting; use of dogs and of cross-bows, as well as bows and arrows.

Fishing; nets; fish-hooks; spears; any javelins or arrows with loose heads attached by a cord.

Modes of cooking, and implements used; any particular observances in cooking or at meals; any separation of sexes at meals. How is fire produced? and are any persons charged with the preservation of it?

Forms and construction of houses. Separation of the sexes.

Furniture of houses.

Plans of towns and fortifications.

Plants cultivated for food or manufactures; agricultural implements.

III. *Religion and Customs.*

Birth ceremonies.

What are the idols and their names? Is there any distinction between them in importance? What worship is paid to them? and what offerings are made, and on what occasions?

Are there any particular superstitions? What fetiches or amulets are used? by whom are they made? Are there any forms of divination, any use of casting lots with cowries, ordeals by poison or otherwise?

Vampire beliefs and ghost beliefs generally.

Cannibalism, and motives for the same.

Funeral rites. Belief in a future state. Deposit of objects with the dead, and whether deposited broken or whole, in or on the graves.

Are burial customs associated with belief in destiny after death?

It is important that the traveller should distinguish between genuine native traditions and those acquired through contact with civilised peoples.

Peace survivals among newer peoples.

IV. *Arts and Manufactures.*

Mode of spinning and weaving; patterns and materials employed.

Dyeing and nature of dyes.

Any mode of preparing and working leather.

Any knowledge of glass-making. If not acquainted with the manufacture of glass, do they melt down broken European glass and beads to make armlets and other ornaments?

Musical instruments: their forms, nature, and names.

Knowledge of pottery and mode of manufacture.

Use and manufacture of tobacco and other narcotics; forms of tobacco-pipes; any ceremonies connected with smoking; use of snuff; snuff-bottles.

Manufacture and trade in salt, wine, beer, or other liquors.

Knowledge of simple medical remedies, cupping, etc.

Ivory and wood-carving.

Metallurgy: working in the various metals, whether by a special class of people or tribes; implements used in smelting, etc. Where are the ores obtained?

Is there any knowledge of precious stones?

V. *Personal Ornaments, Disfigurements, etc.*

Are there any special marks made by tattooing or cicatrices to distinguish the various tribes? are they the same in both sexes? Drawings of these marks would be very desirable, distinguishing each tribe.

Are the teeth filed or knocked out? If the former, into what shapes are they filed? when is the filing effected? and is it the same for both sexes?

Is antimony used for the eyelids? and how is it applied?

Are ear-ornaments worn by either sex? are they pendent or inserted in the lobe? Are there any nose or lip ornaments?

Is the hair cut into any peculiar shape, or is its colour altered by dyeing?

Is any cap or protection worn on the penis, as by the Kafirs and other tribes?

Any peculiarities of dress for men and women? any distinction between married and unmarried?

What protection is worn in battle? What are the forms of the weapons? and is any missile weapon in use?

Is there any mutilation of the sex organs?

Are any marks used as distinctions for bravery, success in hunting or rank?

VI. *Ivory and Wood Carving.*

If elephant ivory is not of native origin, where is it obtained? Are any other materials of the same nature employed in carving, such as walrus-tusk, cachalot teeth, etc.? Are any very hard woods employed; and if so, how are they worked?

VII. *Money.*

What kinds of money are in use? Do the coins pass by weight as bullion, or have they a recognised value? Are any objects such as iron bars or tools, salt, pieces of cotton, cowries, beads, wampum, etc., employed as a means of exchange? If so employed, is there any recognised way in which their value is certified, or is their value the subject of bargain in each case?

ANTHROPOLOGICAL NOTES.

By W. L. H. DUCKWORTH, M.D., SC.D., M.A.

THE following notes deal in the briefest possible manner with the more important observations to be made on human bones; and it is conceivable that some such records might be obtained under circumstances precluding the observer from securing or removing the actual specimens, and even in instances where only a very brief period is available for inspecting them. It is convenient to arrange the observations under the following separate headings:—

1. The circumstances attending the death of the individual should be first investigated, and observations concerning the mode and locality of interment should be recorded (cf. Professor Tylor's Schedule, under 'Funeral Rites').

2. The general condition of the specimen next demands attention. This is to some extent dependent upon circumstances referred to in the preceding section. From the texture and preservation of the actual bony substance, a rough estimate may be formed as to the lapse of time

since the death of the individual. The occurrence of the skull alone, or at a distance from the remainder of the skeleton, should be noted.

3. The greater weight and size, as well as the greater prominence of the brow-ridges and ridges at the back of the skull, serve to distinguish the male *sex*, but in many cases the determination of sex is almost impossible.

As regards *age*, skulls are conveniently described as immature, adult or senile. Immature skulls lack the full complement of teeth or of sockets for these, and a deep cleft is seen to cross the base of the skull about an inch in front of the large hole (foramen magnum) for the spinal cord. Upon the attainment of maturity this cleft is obliterated, by the fusion of its margins. In senile crania, the sutural lines on the surface are almost entirely obliterated, and the jaws are toothless and much reduced in size and prominence.

4. The skull may be deformed. It is important to attempt to distinguish *deformation* produced during life (either artificially or otherwise) from that determined by the weight of superincumbent soil after interment. Artificial deformation is manifested in most cases by flattening of the forehead, or of the back of the skull, or of both. But posthumous deformation is quite irregular, the face is often involved as well as the brain-case, there is often extreme flattening from side to side, and the bones are usually fragile and tend to fall apart.

5. *Trephine-holes*, indicative of enterprise in operative surgery, should be noted. The regularity of contour and the size of the hole often gives the clue to its real nature. It must be remembered that, in the process of exhumation, injuries closely resembling the foregoing operative wounds may be received by skulls, and therefore the circumstances of exhumation demand enquiry in this connection. Some skulls are found to have been incised or engraved with decorative patterns after death.

6. *Craniological descriptions* deal with the appearances presented by skulls in each of the five normal positions or aspects depicted in Fig. 1.

In the first view or aspect (Fig. 1, B) the general form of the skull is shewn, and in proportions the cranial case may be either elongated or rotund; or again, if elongated, it may be elliptical (with no great difference in form between front and back), ovoid (when the hinder end is the broader), or rhomboid (lozenge or diamond-shaped).

In Fig. 1, C, the profile line, and its modification by prominent brow-ridges or jaws, claims attention. In Fig. 1, D, the general form of the eye

(orbital aperture) and naso (nasal aperture), as well as the relative breadth of the face, are considered. Fig. 1, E, shows the palate, and the number and forms of the teeth are studied from this point of view. In Fig. 1, A, the form of the transverse cranial arc, and any irregularities, such as

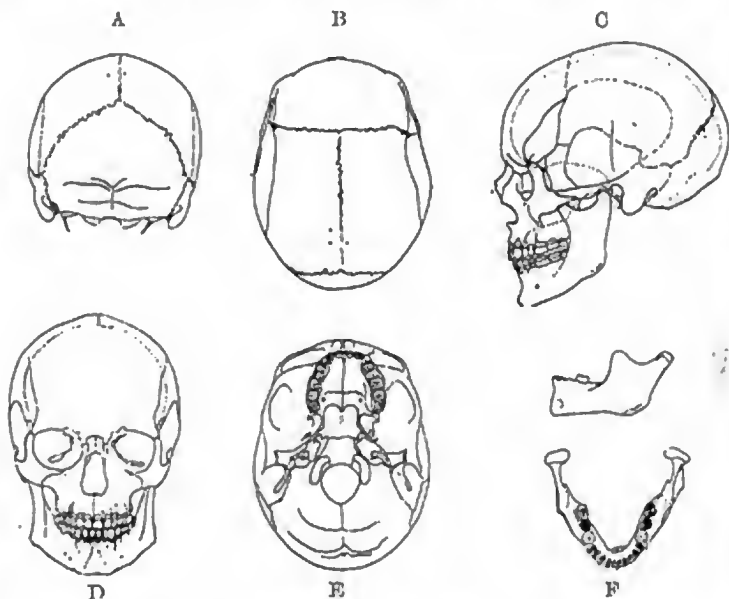


FIG. 1.

The five normæ, or aspects of the human skull, viz.:—(B) Norma verticalis, the vertex view; (C) Norma lateralis; (D) Norma facialis; (E) Norma basilaris; (A) Norma occipitalis.

flattening or the production of a keeled (scaphoid) appearance, should be noted.

7. The *lower jaw* is studied independently. The prominence of the chin, the squareness of the angle, the stoutness of the whole bone, and

the number and characters of the teeth are the chief points to which attention is directed.

8. *Cranial measurements* are made with callipers and a flexible steel or tape measure. These objects, as well as a graduated two-meter rod used for measuring stature or long bones, are supplied in a travelling case by Messrs. Hermann of Zürich, who have made them to Professor

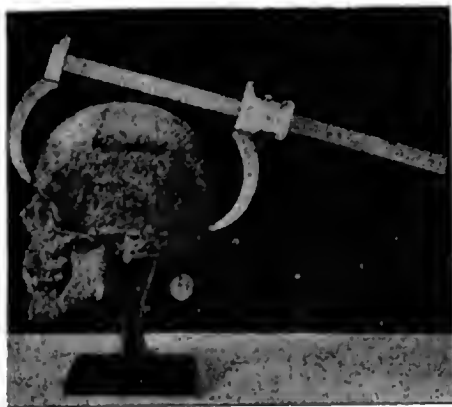


FIG. 2.—Measurement of the length of the skull with callipers (Flower's Craniometer as modified by Dr. Duckworth).

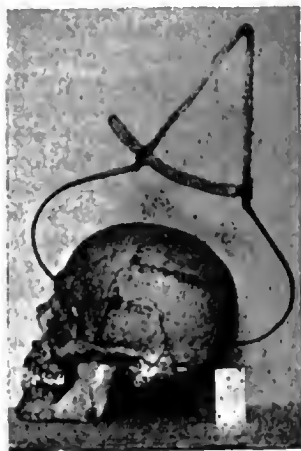


FIG. 3.—Measurement of the length of the skull with another form of callipers.

Martin's designs. The whole outfit costs about £4, but the instruments can be obtained separately. Messrs. Hermann also make a modified form of the callipers, known as Flower's Craniometer (cf. Fig. 2). Measurements are recorded in millimeters, in which the various callipers, etc., are graduated. The latter instruments may have the forms represented in Fig. 2 (Flower's Craniometer) or Fig. 3, in which are shown the exact positions of the instruments in measuring the length of the skull.

The chief measurements may be now enumerated in order of importance:—

i. The *extreme length* of the brain-case, measured as shown in Figs. 2 and 3.

ii. The *maximum breadth* of the skull is measured on the brain-case.

iii. The *circumference* of the brain-case (as distinct from the face) is measured with the flexible tape passed round the brow-ridges and the back of the skull. The measurement is that of the greatest circumference of the brain-case obtainable in this way.

iv. Measurements illustrative of the degree of prominence of the upper jaw are two in number, and are made with the callipers. The two measurements start from the same point behind; this point is the middle of the front edge, or margin, of the hole for the spinal cord (foramen magnum), shown in Fig. 1, E. From this common point, the upper or *basio-nasal measurement* passes to the upper border of the nasal bones in the middle line of the face, and the lower or *basio-alveolar measurement* passes to the extreme front edge of the upper jaw in the middle line, just above and between the upper incisor teeth.

9. *Measurements of the long bones of the limbs.* These are best made by means of a graduated rod with fixed and movable limbs, resembling a large pair of callipers. Such a rod is supplied (as indicated above) by Messrs. Hermann. The bones to be measured are six in number for each side of the body, viz.:—those of the upper arm and thigh (humerus and femur); then two for the fore-arm (called radius and ulna, the former being the shorter); and two for the leg (called tibia and fibula, the former, or shin-bone, being the larger). The extreme or maximum length is measured in each case, excepting those of the femur and tibia.

i. The femur is measured obliquely, that is, from its ball-like head to a line touching *both* prominences at the lower end, as shown at B in Fig. 4. This represents the position of the bone in a person standing erect.

ii. The spiny processes on the upper end of the tibia are not included in the measurement of its length.

Immature limb-bones are recognised by the line which demarcates

the extreme ends, or epiphyses, from the shaft (or diaphysis). Sexual differences are chiefly indicated by greater length, stoutness, and also by the development of osseous ridges in male bones.

10. The measurements of the long bones are used in estimating the stature. Special notice is to be paid to individuals of giant or of dwarf

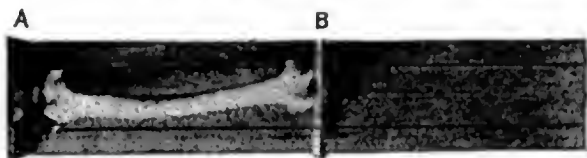


FIG. 4.—Position of the thigh-bone for measurement of its length.

stature. In this connection particular mention should be made in the following instances:—

(a) Where the thigh bone measures more than 52 cm., or less than 36 cm.

(b) Where the shin bone measures more than 42 cm., or less than 28 cm.

(c) Where the fibula measures more than 41 cm., or less than 28 cm.

(d) Where the upper arm bone measures more than 37 cm., or less than 26 cm.

(e) Where the ulna measures more than 29 cm., or less than 20 cm.

(f) Where the radius measures more than 27 cm., or less than 19 cm. (only adult bones being considered, and the sex, where known, recorded).

11. Adult skulls will also excite attention when the horizontal circumference (measured in accordance with the directions provided above) is greater than 56 cm., or less than 47 cm.

VI.

INDUSTRY AND COMMERCE.*

By SIR JOHN SCOTT KELTIE, LL.D., *formerly Secretary, R.G.S.*

THE kind of information desired under this heading may be summed up in the three following questions, so far as uncivilised or semi-civilised countries are concerned :—

- (1.) What are the available resources of the country that may be turned to industrial or commercial account?
 - (2.) What commercial products can find an available market in the country?
 - (3.) What are the facilities for or hindrances to intercourse between the country and the rest of the world?
- Or, briefly, (1) Resources; (2) Wants; (3) Accessibility.

These include the questions of suitability for immigration and colonisation.

What is known as commercial geography is one of several special applications of geographical knowledge. From this practical point of view, therefore, the observations collected under other heads in this book will be of service, especially if the requirements of commerce are kept in view at the same time as the *desiderata* of science. From this standpoint, the sections on Meteorology, Geology, Natural History, and Anthropology should be consulted. Even general geographical and topographical observations will be of practical service—the general lie of the country, its altitudes, and its character at certain altitudes, its mountains, hills, valleys, plains, rivers—if regarded from the special standpoint of habitability and possibilities of development.

* Some useful training under this head can be obtained at the London School of Economics.

The suggestions contained in this, as in the other sections of this manual, are meant both for the ordinary explorer or traveller who may have to pass rapidly through a country and for those who may have more opportunity for making leisurely observations. To the former the following brief hints may prove serviceable:—

Observe and note—

1. As regards **RESOURCES**:—

The extent or quantity, quality, facilities for raising or collecting, for transport and shipment, etc., of

- (a) The natural products, such as minerals and metals, especially gold, silver, coal, iron, copper, tin, nitre, guano, phosphates, etc.; timber useful for various purposes; vegetable products, useful for food, fibres, dye-stuffs, or medicine—gums, resins, etc.; animal products useful for food, skins, fur, feathers; rivorine or lacustrine products, useful for food, oil, or other purposes.
- (b) Substances cultivated for food or for manufacturing purposes.
- (c) Articles manufactured for clothing, for domestic, warlike, or other purposes.
- (d) Native methods of developing resources, of carrying on manufactures, and of transport.
- (e) Practicability of developing the resources of the country by European methods.

2. As to **WANTS**:—

- (a) What particular things used by the natives could be profitably supplied from the outside?
- (b) What do the natives lack that might be introduced and supplied from the outside?
- (c) In all cases be particular to note favourite materials, shapes, colours, or other peculiarities, as of cloths, implements, ornaments, such as beads, anklets, etc.

3. As to **ACCESSIBILITY**:—

Note the nearest ports and railways; the character and connections of native roads, if any; the navigability of rivers,

inlets and lakes for various kinds of craft at various seasons of the year; heights of passes, whether suitable for animals or only for porters, whether blocked at any season of year; routes likely to be suitable for railways.

In all cases where practicable, specimens of products should be obtained, in order that specialists at home may judge of their industrial or commercial value.

For those who may have more leisure for observation, some or all of the following detailed hints may be useful:—

MINERALS AND METALS.—It is not necessary to add much here to what has been said under Geology. If the traveller is not himself competent, or has no opportunity to test the value of these products, he should bring home specimens; this, if possible, should be done in any case. Under this section a look-out should be kept for any indication of naphtha, asphalt, or mineral oils. From the commercial point of view the important points are—

Quality.—To what extent are minerals or metals, as gold, copper, iron, phosphates, mixed up with other matter? What is the yield per ton of ore? In the case of coal, how does it burn, and what is the percentage of ash? Next—

Quantity.—Does the substance occur in sufficient quantity to make it worth expenditure of capital and labour? The information must be obtained by personal inspection. Finally—

Locality.—Is the situation of the deposits easily accessible? How are they situated with reference to routes, existing or practicable? and how with reference to ports of embarkation? Could they be worked with the resources available in the country, or would labour and machinery require to be introduced? If worked in the country, is there any neighbouring market for the manufactured products? What are the native processes (if any) of obtaining and working minerals?

We must again refer to the section on Geology for further details, and the intending traveller would do well to take a few lessons before he leaves, so as to be able to recognise the most common and useful minerals and the conditions under which they usually occur; he will thus save much time and trouble.

VEGETABLE PRODUCTS.—The directions for observation and collection given under the Botanical section should be attended to; and it is important that the traveller should be able to recognise the chief classes of plants, so that specialists may be able to pronounce generally on their utility.

Character of Surface.—The general character of the surface of a country, so far as its vegetation is concerned, should be clearly grasped. What proportion, or, if possible, what area is under forest? what under grass? what desert, or mountain, or marsh, or uncultivable? what under cultivation?

Forests.—If of a generally forest or thickly-wooded character, are the forests extensive and dense, with much undergrowth, as in tropical South America? or easily penetrable, as the forests of Europe and North America? Or are the trees scattered, either in clumps, or singly, as in a great part of Central Africa? Do they prevail over the country generally, or are the river-banks only lined with dense tree vegetation? Are the forests only found in the low country, or do they cover the hills and extend up the mountains?

Timber.—Ascertain the leading characteristics of the trees of the forests. What are the prevailing families, and, if possible, genera and species? What uses, if any, do the natives make of the woods? Which do they use for their houses, their furniture, their canoes, their weapons, their ornaments? How do the woods seem to stand tear and wear, the climate, the attack of destructive insects, immersion in water? Are there any woods that would do for such purposes as railway-sleepers or telegraph-poles in the conditions which prevail in the country? Any ornamental woods suitable for cabinet purposes?

Fibres, Fruits, Chemicals, etc.—Are there any plants the fibres of which could be turned to account? Any fruits adapted to human consumption, and are they found in any quantity, or could they be cultivated?

Are there any trees or other plants suitable for drugs or chemicals—bark, leaves, juices, roots? What medicines, narcotics, or stimulants are used by the natives? how are they obtained and how prepared?

Are there any species of useful plants growing wild—coffee, sugar, cotton, vanilla, spices, etc.? Any trees producing gums that might be of commercial value, like gum arabic, gutta-percha, or caoutchouc? Or any whose fruits yield oil, like the cocoa-nut and the olive? Do the

natives make use of these juices? What are the processes of extraction and preparation?

Other Vegetation.—When there is an undergrowth, its character should be noticed, and the diseases, if any, to which trees are subject.

Note what other vegetation exists besides that of trees. Are there any plants like the turnip, the potato, the batata, which are useful as foods, or for other purposes? Specimens of any herbs likely to be useful should be obtained, especially if they are used by the natives for medicine, for dyeing, for poison, or other useful purposes.

Sometimes, as in Central and Western Australia, what arborescent vegetation exists consists mainly of shrubs, the character of which should be noted. Do they hinder locomotion? Are their shoots useful for forage? Are they injurious to horses and cattle?

When there is herbaceous vegetation of any extent, what is its character? Is it tall and coarse and reedy, like much of the African grass? Or such as is found on the prairies and pampas? Or of a troublesome spinifex character, as in Australia? Or of a turf-like character, like the grasses of Europe? What are the components of this kind of vegetation, and how far is it likely to prove useful as fodder? What uses do the natives put it to, either for their animals or for manufactures? Do they use it for making mats or cloth? Are there any plants mixed with it injurious to animals? What is the condition of the grass at different seasons of the year? When is it at its best, its strongest, its densest? Is it liable to be parched up at any season? To what extent is its condition affected by the climate, by rainfall, by irrigation, natural or artificial? Is it easily removed, in order to make way for other cultures? Does it spread into the forest region, and has it any special characteristics there? How does it, as well as other useful vegetation, vary with altitude or other local conditions? Do the products change under different agricultural conditions? e.g., some are poisonous under certain conditions, not others?

Marshes, Deserts, Irrigation.—Note if marshes or peat-bogs, or other special features of the surface exist to any extent, and whether the drainage of marshes is practicable.

Where deserts exist, note their character. Are they sandy, gravelly, rocky, salt? What is the prevailing rock? If the desert character of the land (as is generally the case) seems due to want of water, is there

any artificial means likely to be available for supplying that want? Is there any storage of water and irrigation among the natives? and, if so, how is it accomplished? and what are the results? Are there any sources within reach, either above or underground, from whence a supply of water for irrigation purposes could be obtained? Indicate any exceptional defects of quality in the supply of water.

Note if any part of the country is liable to periodical inundations. At what periods of the year do they occur? Are these inundations destructive, or are they utilised for agricultural purposes? Would it be possible to regulate these inundations?

AGRICULTURE.—The general outcome of all these observations is the suitability of a country for agricultural development. What articles do the natives cultivate, if any? Has the cultivated land any special character, or is it simply the ordinary land cleared of trees or grass, or other wild growth? Note the methods and implements of culture used by the natives; the seasons of sowing and reaping, and preparing the crops for use. Do they depend for water on rainfall or irrigation? To what altitudes is cultivation carried, and what are the crops that prosper at these altitudes?

From the point of view of colonisation and agriculture, precise information as to the nature of the soil is desirable. The proportion or extent of a country suitable for agriculture might be noted. Observe, as precisely as practicable, the nature and depth of the upper layer of soil. The depth—it may be a few inches, or it may be two or three feet—can easily be ascertained. A general idea may also be given of its nature. Is it mostly vegetable mould, as it is likely to be in old forest or grass countries? or peaty? or marshy? If possible, also, ascertain the depth of the subsoil down to the rock or clay, or other permanent basis on which it rests. In a general way it might be observed whether the soil is sandy, gravelly, stony, calcareous, marly, clayey. Also is it compact, tenacious, or loose, and, above all, is it permeable or impermeable to water? Is the soil very dry or very moist? or what is its intermediate stage?

If the natives carry on cultivation, ascertain, if possible, the yield per acre of what they cultivate. Do they cultivate only for their own wants? If not, where and what is the nature of the market to which they send the surplus?

Does the country seem suitable for other cultures besides those carried on by the natives?

ANIMAL PRODUCTS.—If there are wild animals in the country, observe whether the natives hunt them for what they yield in the way of food or other useful products. Are there any ivory-yielding animals, or animals whose skins can be turned to profitable account? Could a sufficient supply for mercantile purposes be obtained by means of native hunters, if properly encouraged; or how would it be best to work such resources? Are there any laws or customs enforced by the natives in hunting wild animals? Are there any noxious wild animals, and to what extent do they affect human comfort and human life?

Domestic Animals.—It is important to know what domestic animals the natives possess, how they are reared and fed, and what uses they are put to. Also whether the country is good for horses, cattle, sheep, and poultry, and approximately what is the extent, situation, and accessibility of the grazing-lands. Are the pastures perennial? To what extent do they depend on rainfall, or irrigation, or on intermittent streams? During what months of the year are they available? Are there any plants among the pastures injurious to animals? Are there any insects (like the *tsetse*) or other animals injurious to cattle or horses? Do horses or asses exist among the natives, and what uses are they put to? If not, would they be likely to flourish, if introduced?

Fisheries.—Information concerning fish and fisheries is desirable; and among fish, from the practical standpoint, are included shell-fish (especially pearl shells), sponges, corals, and animals of the whale and seal kind. If the natives practise fishing, either in lakes, rivers, or the sea, ascertain the kinds of fish they capture, their methods and implements, and the particular seasons at which fishing is practised. Are the fisheries, whether worked by the natives or not, likely to be of commercial value?

TRADE.—Much of the information suggested above will be of service from the special commercial point of view, especially with reference to export. Information should be obtained concerning any manufactures carried on by the natives besides what has been suggested above—manufactures in metal, in wood, in clay, or stone; in materials derived from the vegetable and animal kingdoms, what they are, what uses they are put to, what processes are used, and to what extent, if any, they

form articles of trade. With regard to the import market, what generally are the wants of the natives and what new wants might be created. If possible, some approximate estimate of the value of the leading classes of imports, if there are any, should be obtained.

Ascertain if any goods are brought into the country from the outside; if so, what they are, where they come from, and as accurate an estimate as possible of quantity, or value, or both. In the case of imports from civilised countries, are those of any particular country preferred, and, if so, why? Is it owing to anything special in quality, or pattern, or cost, means of communication, or in quantity available? Is there any special tribe of middlemen who prevent the inland people from coming into direct relation with traders? Probably a market could be created for outside manufactures which have not as yet been introduced into the country; or such manufactures might easily obtain a market in preference to those of native make. Note especially the patterns of articles of native make, as these are probably adapted to the conditions of the country, and should therefore be imitated or improved upon in the case of imported goods, the quality of the latter being better, and the cost, if possible, lower. British traders, especially, often incur serious losses by not ascertaining in advance what particular articles and what special patterns are in demand among natives. Note also whether European methods might not be introduced with advantage for the manufacture of native goods. Native usages as to credit ought to be ascertained, what safeguards are binding, what is the medium of exchange, etc. It would be useful to discover beforehand whether the importation of machinery and explosives is likely to be unimpeded.

CLIMATE.—This is an essential item, so far as the exploitation of tropical and semi-tropical countries by Europeans is concerned. Its main elements are determined by temperature, latitude, altitude, and rainfall; the character of the surface should also be taken into account. Under Meteorology, the main directions on the subject are given. The temperature at different seasons and at different times of the day (say 9 A.M., 8 P.M., and 9 P.M.) should be ascertained, and that at various altitudes. Rainfall observations are not of much service unless they can be obtained over a continuous series of years. Ascertain the distribution of rainfall over the year, and the limits of the rainy period of the year, when such period

exists, and, if possible, the quantity which falls in the different months of the period; how does the rainfall differ with altitude and other topographical variations? If a country is subject to droughts, it is important to ascertain if there is any periodicity in these droughts, and how they affect the resources and prospects of the country, and the condition of the rivers. Would it be possible, by storage of water or other means, to counteract to any extent the bad effects of drought?

What effect has the rainy period and the drought period on the native inhabitants, and especially on Europeans? As far as possible, ascertain the birth and death rate per annum.

FACILITIES AND HINDRANCES TO COMMERCIAL DEVELOPMENT.—Under this head the first consideration is Accessibility or Means of Communication. Generally, the quickest, cheapest, and safest routes to a satisfactory market should be ascertained.

Water Communication.—Observe what natural means of communication exist, what is the nature of communication between the country and the outside world. If communication by sea is of importance, how is the interior to be reached from the sea? Are there any deep inlets? Is there practicable river communication? For what sort of vessels is it adapted? Are there any obstructions in the river, and, if so, what is their nature, and how could they be surmounted? What is the width of the river, the depth of the water, and the force of the current, at various distances from the mouth, and at the periods of the year when the river is at its lowest and highest? Are there any lakes that could be utilised for communication?

Roads.—If there are native roads, state precisely what is their nature under various conditions of weather; their width; what sort of vehicles, if any, they are suited for, and where they lead to. If the country is mountainous, ascertain the principal passes, what places they connect, their exact heights at the highest point (not the heights of the mountains), for what animals or vehicles they are practicable, or if only for porters, and what is their condition at various seasons of the year. If the natives have any vehicles, or vessels, or other means of transport, describe them.

Railway Routes.—Observe, as far as possible, suitable routes for railway or canal communication, as well as for good roads, and whether any materials for railway construction are obtainable in the country.

Possibly the country, if an inland one, could be connected by road or rail with some existing railway system. What are the nearest telegraph stations?

Labour.—Another important consideration under this head is that of labour—labour for the varied enterprises connected with the development of a country's resources. Is labour obtainable within the country itself? If so, to what extent, and on what terms? Are the natives industrious, and are they likely to labour under foreign superintendence? Does slavery or forced labour in any form exist? If not obtainable in the country, how may labour be most easily and cheaply obtained? Is the country suited to manual labour by whites? If there are only certain kinds of labour in which whites may engage, state what they are.

To what extent could machinery be used with advantage? Is there any water power available? or any animal power?

Currency, Tariffs, etc.—Under this head also questions relating to currency should be included, or whatever other medium of exchange exists.

Another important consideration here is the question of tariffs, which, in one shape or another, exist in nearly all uncivilised and semi-civilised countries, from the hongo of Central Africa to the Customs duties of Eastern countries. Precise information concerning these, both as to exports and imports, is important.

Note, also, as precisely as practicable, the cost of living for Europeans settling down for a time, and the expenses involved in travelling through a country.

Inhabitants.—Is there anything in the character of the natives—physical, mental, or moral—likely to affect commercial intercourse or the industrial development of the country? Any prejudices or superstitions that should be attended to? Anything in the attitude of natives to traders and settlers deserving consideration? Is the population nomadic or settled? What material, if any, do they use for smoking, and what is the nature of their intoxicating drinks, if they have any? Estimate, as nearly as possible, the population, the density per square mile, both for the country as a whole and for the chief centres of population. Ascertain the nature of any political or social organisation which exists. What are the terms on which land can be acquired? What are the prevalent crimes? Under the Anthropological section directions are given for ascertaining the leading racial characteristics of the people.

VII.

ARCHÆOLOGY.

By D. G. HODGARTH, C.M.G., M.A., D.LITT.

THIS section is intended, not for experts, but for those travellers without special interest or experience in archæological work, who, finding themselves in districts where unpublished antiquities exist, feel it incumbent to record or rescue them. General hints, therefore, are subjoined on methods of recording, cleaning, temporarily conserving, and conveying monuments and objects of antiquity.

A.—RECORDING.

There are three ways of obtaining a record of a monument, all of which should be used if possible in cases of importance:—

1. Mechanical reproduction by photography, moulding, or rubbing.
2. Reproduction by planning, drawing, or otherwise copying.
3. Literary memoranda of characteristics, *e.g.*, dimensions, subject, etc.

1. *Mechanical Reproduction.*

(a) *Photography.*—This subject has already been dealt with in Part II., and it is only necessary here to add a few hints, peculiarly applicable to the photography of objects of antiquity.

Of inscriptions photography does not, as a rule, supply a useful reproduction, and unless time or other opportunity be wanting, it should not be the only mechanical process applied. If an inscription is at all worn, or the material on which it is engraved contains superficial faults, do not rely on a photograph; but if one is taken, try to dispose the object so that light falls on it from one side, with a slight obliquity from above. In

the case of rock inscriptions or others still in their place on walls, etc., a photograph should be secured to show relative position and surroundings. An inscription on dark material will often need preparation with white chalk before being photographed to any good purpose; but the traveller who has opportunity to do that, will probably have equal opportunity to employ the better process of moulding.

For *sculpture*, photography will often be the only method of reproduction possible to the traveller. When that is the case he may be advised (1) to take his photographs on the largest possible scale; (2) to take the object from all possible points of view; (3) to do what he can to improve the light and relief of the subject. Small objects gain enormously by reflected lights carefully arranged to bring out their contours; if sufficient mirrors are not obtainable, strips of tin or even white paper will serve as reflectors. Backgrounds may be chalked or blacked as the case may be, but in the case of a relief this should only be done when the outlines are very clear. If a sculpture on rock or other material is much broken or worn, a good mechanical method of improving relief, which Professor Petrie recommends, can be used; this consists in dusting the face with powdery sand and then fanning it. The result, if carefully done, is to leave hollows and background in strong contrast to the surface of the relief. Highly polished or lucent surfaces should be dulled before photographing. Metal objects do not, as a rule, photograph very satisfactorily; and of coins it is much better to take a cast and photograph that. Perhaps it is not superfluous to remind the photographer to make notes of all colouring before leaving his subject. On preparing sculpture, etc., for photography there are valuable practical hints in Professor Petrie's '*Methods and Aims in Archaeology*,' Chapter VII.

For *small objects of antiquity*, photography is not of much service unless a camera with very long extension can be used. If it be possible, the best way is to lay the objects on a sheet of glass raised about a foot from the ground on a frame, and arrange the camera above, so as to photograph downwards. This process obviates all ground shadows, and all pins or other supports for the objects, which appear sharply on the negative as if suspended in air.

For *buildings* photography is, of course, the only method of mechanical reproduction possible.

(b) *Moulding*.—This in almost all cases will have to be done by

impressing *paper*. Only in the case of small objects will a traveller ordinarily be able to use either *plaster of Paris* (if he can procure it) or *sealing wax*. As to the latter he may be reminded never to heat his wax by putting it in direct contact with a flame, or the impression will come out so parti-coloured or black as to be of little use; a card should be held over a candle or lamp, or, better, a spirit burner, and the wax rubbed upon the gradually heating upper surface till enough has melted on to the card without boiling. A useful impression may be obtained of coins, gems, etc., by pressing ordinary tin foil upon the surface; but great care must be taken afterwards that the impression does not get flattened out in transport. Mr. Petrie recommends floating impressed foil on water face downwards, and dropping hot wax upon it, as a solidifying agent.

As to the use of plaster of Paris it may be remembered that (1) the proper mixture is just as much plaster as will absorb the water, leaving none standing on the top; (2) the object must be well cleaned and soaped before being moulded; (3) the plaster must be applied *very rapidly*, in a thin coating all over the object at once: it can be backed with more plaster afterwards; (4) a surface of any size should either be moulded in sections, or, if done all at once, the plaster will probably have to be cut into sections afterwards for transport. To cut it, it is best to lay strings upon the object before moulding, which, later, can be pulled up through the plaster while still viscous.

Paper moulding or '*squeezing*' is, however, the ordinary process employed. Any fairly strong *unsized* paper will serve more or less well, but a special '*squeeze*' paper is procurable in most large cities where there are archaeological museums (*e.g.*, in London, from Nutt's, 57 to 59, Long Acre, W.C.; in Paris, from Moreau's, 11, Passage du Pont Neuf; in Berlin, from Ebers Brothers. It can also be got direct from the maker, Papierhändler Dorr, Spiesgasse, Strassburg.) Mr. Maudslay recommended in a previous edition a hand-made paper, used for packing oranges in Spain, and to be obtained of Messrs. Batalla, of Cacagente, near Valencia, through the agency of Messrs. H. King & Co., Cornhill. Failing these, the paper on which the commoner news-sheets are printed will do. The other implements needed are a sponge, and close-bristled, not very hard, brushes of two or three sizes, *e.g.*, an ordinary clothes-brush, a nail-brush, and a tooth-brush, if no others are at hand, but special brushes with hand-straps on the back, or curved handles to

keep the knuckles of the beater away from the stone, are preferable. In the case of an ordinary inscription, of not specially rough or uneven surface, brush and clean the stone thoroughly, and pick all accumulation out of the letters; then wet it thoroughly all over; lay the dry paper, cut to size, as flat on the surface as possible, and dab it down with a very wet sponge till thoroughly soaked; take the largest brush and pound the paper rather gently all over, till it partially adheres; then take smaller brushes and work the paper into all depressions with the maximum pressure you can exert; finally, hammer it with the large brush again, working systematically from top to bottom or side to side, not minding the surface becoming mashed, and driving the air-bubbles, which collect under the paper, before you and out at the farthest point. If the stone was thoroughly wetted before the paper was laid on, these ought not to be numerous or troublesome. Then, if the surface of the stone has penetrated through the paper at any point, lay a second sheet and, if necessary, a third, or more, and treat as the first was treated. Leave the sheets, if possible, to dry on the stone, and all will come off as one with a perfect reverse impression of the stone's surface. Some soak the paper before laying on the stone, but if that is done and there be any wind, the paper, become very tender, will be apt to tear with its own weight while being laid on, and will be difficult to lay flat. If for any reason, *e.g.*, overhanging of the stone's face, it is difficult to make the paper adhere, the task will prove easier with small pieces. But whenever a surface is squeezed by sections, the operator must be careful to make the edges of his sheets overlap, so that later all can be gummed together as one sheet; to number the sheets according to a key-plan, recorded in his note-book, and to mark on the sheets themselves the lines of junction. All superfluous edges should be peeled off, as they are apt to lift in the wind and cause all or a part of the impression to become detached before it is well set, and weights should, if possible, be laid on the drying paper. If for any reason the paper cannot be left to dry in position, peel off carefully and lay out to dry reverse side uppermost. The impression, so taken, will be hardly less good. When dry, roll the squeeze inside a tin cylinder, and only very rough usage will harm it.

Squeezing sculptures is a more difficult matter. Mr. A. P. Maudslay gave very full directions in an earlier edition of these "Hints" which may be repeated here. After stating that all moulds of sculpture have to be made of

many thicknesses of paper, with a good coating of paste between every few sheets (not only because of the great inequalities of surface, which break through the paper, but also in order that the mould, when dry, may be stout enough to keep its shape), he said :—

‘Paper can only properly be applied for the purpose of moulding when the carving is free from large contours and deep undercutting; but it is wonderful what accurate results can be obtained even when large curves and some undercutting have to be contended against. Where worn or splintered parts of a wood-carving, or fissures in a stone, or deep undercutting which is not essential to the design, occur, it is often of advantage to fill them up with clay or paper, to which a smooth surface can be given, so that the mould will come away free from them when it is dry; and careful notes and measurements will often enable one to restore the contour to a mould which has suffered some pressure in transport. In a properly-made mould the detail of carving is never lost, unless the paper itself is destroyed.

‘A shallow tin bath (or two made to fit inside one another), large enough to hold an open sheet of paper, is useful for soaking the paper in.* Twenty sheets or more may be placed in the water at once, and left there without harm for an hour or more; but a few minutes’ soaking is quite enough.

‘I have several times had to mould, in America, the whole of a monolithic monument—one as much as 25 feet in height—covered with carving and hieroglyphic inscription, and have been perfectly successful in reproducing it in plaster in England. Each face would be marked out into three or more sections, and each section would be moulded separately, great care being taken that each mould should considerably overlap the margin of the other, so that when each section is cast in plaster the edges of the cast can be cut away until the joint is perfect. And each section should also overlap at the top and sides in No. 1, and at the sides in No. 2, &c., for the same reason; and it is necessary to pay careful attention to the beating in of the paper near the sides and edges, as it is there that the layers are most likely to come apart when dry. These edges can be trimmed down afterwards, if found too bulky in packing.

* In the case of sculptures, owing to their deep depressions, it is best to wet the paper *before* laying on.—*Ed.*

'The first sheets of paper should always be put on singly, and well beaten in. If the carving presents many sharp angles, the paper will again and again be broken away over them, and small scraps of paper may be used for covering them up, until the whole section is covered at least three papers deep in the thinnest place. The coat of paste should then be given. If the paste is laid on when the mould is too thin, it will penetrate to the stone, and prevent the mould coming off when dry. The paste may be put on warm, but if too hot it draws the paper from the stone (if it is a stone sculpture); air gets underneath the paper, and it is very difficult to get rid of it again. Avoid, in putting on the first papers, doubled edges or creases, and beat in well, so that the paper may work into the grain of the stone or wood. It is easy to spoil a mould by scamping the work in it, but not easy to spoil it by overheating. After giving a coat of paste with a brush, it is advisable to work in the paste with the fingers, so as to be sure, from the smooth feeling, that it penetrates the paper over the whole surface.

'After the first coat of paste has been applied, a good deal of time may be saved by employing an assistant to beat out the paper for the further thickening of the mould, for when thus beaten out, two or three thicknesses of paper can be laid on at the same time. Take about six sheets together from the water, fold them, and then double them twice, and slightly tear the wet doubled edges, so that when the sheets are laid open again there are a number of small slits in the paper; then lay them out together on any flat surface, and beat them out with a brush for a few minutes. It is easy to separate them again into the required number of sheets in thickness.

'Another method which is equally good, if not better than the last, is, after making the tears in the doubled sheets as before, to unfold them, and then to roll them together and twist them up like a rope, and rub them well between the hands; then unroll them and beat them out for a moment, separating as many sheets as are required. Either of these processes loosens the fibre of the paper, whilst the slits prevent it stretching unevenly. After this treatment it feels to the touch more like wet leather than paper.

'As the mould grows thicker the pulpy paper will, from the continual beating, find its way into, and fill up, the deeper cutting; but it should be most carefully watched that the mould is not left too thin over the

more prominent parts of the surface, and, with a little practice, the thickness is easily judged by the touch. It is always well to use the fingers frequently both in pressing the paper into its place and working in the paste.

'It is difficult to lay down any rule as to the thickness of a mould and the number of coatings of paste necessary. If the mould is of large size, and the carving presents prominent angles or large curves, it may need an average of thirty sheets in thickness to preserve its shape, and three or four coatings of paste; but if the carving is in low-relief on a flat surface, less than half the thickness will suffice.

'In hot weather, out of doors, a mould will take about twenty-four hours to dry; but it should be covered up at night from the dew. In damp forests or in bad weather I have dried most of my moulds by building up large wood fires at the distance of a few feet from the sculpture.

'It is best to take off a mould when it is cool—in the morning or evening. *Don't be in a hurry about it.*

'If the mould is torn or broken in taking it off the carving, mend it with paste *at once*.

'When a mould is taken off, lay it to dry in the sun on a flat surface, as there is usually some moisture left in it. If the mould is not flat in shape, support it carefully, so as to preserve the contours.

'When the mould is quite dry, it is advisable, but not necessary, to give it, both back and front, one or more coats of boiled linseed oil. Heat this oil before applying it, and it will then soak in well, and use rather a soft brush, and be careful, in oiling the surface of the mould, not to rub too hard. As the paper easily absorbs moisture, the moulds need to be carefully packed.' Plaster casts can be taken very successfully from paper moulds. See directions for casting above.

(c) *Rubbing* can only be practised on a fairly smooth surface, and has nothing to recommend it except the ease and celerity with which it can be done. The traveller may as well carry a little heel-ball in his kit. Any thin, tough paper will do.

2. Other Reproductions.

Planning and *drawing* are dealt with in Vol. I. of these 'Hints.' *Copying*, as distinct from either, applies to inscriptions. A hand-copy of

an inscription as well as a mechanical reproduction should always be made, partly because it has the better chance of surviving the accidents of travel, partly because, if a stone surface is at all perished, anyone with a keen eye and power of concentration ought to see more lettering on its worn parts than will appear on a photograph or 'squeeze.' The copy should be as near a facsimile on a reduced scale as time and other considerations will allow. It should be made on ruled paper, if possible on paper ruled in squares (*en quadrille*), and the relative position of the letters to one another must be kept as far as possible. All broken parts of letters are to be scrupulously copied (they can often be distinguished from stone-flaws by feeling along the bottom of the groove with a knife-blade; if that finds an even line, the groove is probably part of a letter), and all intervals where letters have perished beyond the copyist's power to recover them should be measured, and by comparison of equal intervals containing decipherable letters in other parts of the inscription, the number of lost letters can be estimated. These should be indicated by dots in a shaded patch. Letters, about which the copyist is not quite certain, must be dotted or drawn in faint line. If a stone be imperfect at the sides, and there be any means of estimating its original breadth, the line of its true centre should be marked on the copy. Such an observation will be invaluable to the restorer of the text. All letters that have peculiar forms should be carefully drawn at least once, as specimens. If the text is grouped about, among, or in any relation to, sculptures, such relation should be indicated, even if the whole sculpture be not drawn. Marks of punctuation or division, ligatures of one letter with another, and ornate initials and finials, should be looked out for and noted. On beginning a copy it is well to transcribe first the most obviously easy parts of the inscription: they will give an inkling of the character of the text, teach the forms of lettering used, and accustom the eye to the inscribed surface. On finishing a copy, if there be time, read it over, try to translate it, and in the light of the probable translation, attack again the harder parts of the inscription. In the case of stones with two or more texts inscribed one over the other (as frequently happens on Roman milestones, which may be geographical documents of great importance), a 'squeeze' must be got at all costs, for an untrained copyist will make little or nothing of them, and find it very difficult to draw an accurate hand fac-simile.

3. *Literary Memoranda.*

It is impossible to make too many notes of a monument, and quite easy to make too few. The nature of the great majority of such notes must be left to the discretion of the traveller; but concerning all antiquities, from buildings to beads, it may be said that, at any rate, material, colour, dimensions, condition of preservation, arrangement of parts and character of ornament must be jotted down in the ever ready note-book. In the case of buildings, notes giving all dimensions are especially important, since the camera can seldom be brought to bear on all parts and details, and there is often not opportunity to draw out a plan on the spot. Of inscriptions certain facts must be recorded, viz., form of the stone; condition of its surface; the material and colour; on what sides complete, and on what not; actual dimensions; height of lettering; general character of lettering; whether well or ill cut, plain or ornate. Epigraphists' note-books are procurable in Germany and Austria containing divisions for the notes on all these points, together with a ruled space for the actual inscription. In the case of coins, the material, the ancient value, the weight (if possible), the state of preservation, and the images and superscriptions should be noted; of sculpture, the material, the dimensions, the degree of finish, and a minute analysis of the subject, the dress of the figure or figures, their gestures, attributes, and so forth.

B.—CLEANING AND CONSERVATION.

The traveller will not have occasion to render more than 'First Aid' to objects of antiquity, i.e. to clean them so that their true character may appear, and to consolidate them with a view to safe transport. He should do the least that is absolutely necessary, leaving all elaborate treatment to experts at home. The hints here given are therefore elementary, and concerned mainly with portable objects. In this connection these are best classified by the materials of which they are made.

(a) *Gold*.—Gold requires no immediate treatment, unless it be laid over a core of other metal, e.g. copper or bronze, which has oxidised out through cracks. This oxide can usually be removed by picking or by sharp scaling blows with a small hammer and chisel. If it is obstinate,

use dilute hydrochloric acid laid on with a brush. The proportion of pure acid should not be more than one part to ten of water.

(b) *Silver*.—If in very much corroded condition, technically known as 'dead,' silver should be left alone. If there is only slight superficial corrosion, soak in a solution of common salt or lemon juice, or strong ammonia, and polish after a few hours. If there is a good deal of chloride on the surface, but the body of the metal seems sound, put zinc or iron in the solvent and the chlorine will pass over, leaving a powdery surface which can be brushed clean. Silver should never be packed in a tin box, even if wrapped up, or it will be found on arrival at home to be stained with a brown rust, very difficult to remove. Pack in wood or cardboard.

(c) *Copper and Bronze*.—Both copper and bronze objects are best cleaned, if possible, with hammer and burin. Bronze, however, which the traveller will meet with most often, is frequently covered with a corrosion which cannot be scaled off at once, and calls for an acid solvent. Diluted hydrochloric (1 : 10) will act most quickly and effectually, but it leaves a white oxy-chloride coat, not easily got rid of either from the metal or the fingers of the operator, which it stains deeply. On the whole, we recommend that (1) if the bronze be badly cracked it be left alone; (2) if not cracked, but covered with very hard corrosion, soaking in a weak solvent like lemon-juice be tried; and (3) after that (or before, if the corrosion will yield to a tool at all) every effort be made to pick or flake off the corrosion, after which the object should be rubbed well with oil in the palms of the hands.

(d) *Lead and Iron*, after oiling, are both best left alone by the traveller.

(e) *Stone*.—The traveller will seldom or never be under the necessity to treat stone surfaces, except in the case of inscribed marbles on which carbonate of lime has formed, or small objects attacked by salt. The former can be cleaned with strong acid; the latter must be soaked in water for long periods, and when drying laid with the most important surface downwards, so that evaporation into the air may take place through the less important surfaces.

(f) *Pottery and Terra-cotta*.—The same enemies, carbonate of lime and salt, attack pottery and terra-cotta, and are met in the same way as in the case of stone; but the hydrochloric or other acid solvent should be weaker, and where there is colour be very cautiously used, if at

all. In packing vases, it should be remembered that if many are put into one case without partitions, and one collapses, this will probably entail the breaking of the lot. Large vases should be filled with tightly rammed packing. Nothing of heavier or more solid material, *e.g.*, stone, should be put in a case with pottery.

(g) *Wood, Ivory, and Bone*.—These materials are generally found flaked, split, or scaly, and need consolidation before packing. The methods most likely to be open to the traveller are: (1) if the objects are not excessively tender, to dip them in melted vaseline, let this set, wrap in tissue paper and pack carefully in cotton wool; (2) if the objects are very tender or rotten with salt, to make a stiff jelly, drop them in before it sets, and convey them home in aspic. On the way the jelly will absorb the salt. In addition to either process, it is often well to bind the object in every direction and part with fine thread to keep it from splitting, or prevent the sections, if already split, falling apart and splintering or warping in different directions. If there is crystalline carbonate of lime on the surface of bone or ivory, it had better not be touched except by experts.

(h) *Papyrus*.—Papyrus needs damping and flattening out as far as possible without breaking its fibre. Lay it between two damp towels, and after flattening, pack it between sheets of paper in close tin boxes, filling each box up tightly. But the traveller will be wise not to try too much. As soon as the edges of his roll or fragment cease to be brittle to the touch he had best leave the papyrus as it is without further unrolling, and pack very carefully away.

(j) *Glass, Glazed Objects, Pastes, Amber, Various Compositions*.—None of these should the traveller try to treat. Glass must be left wholly alone if in a flaking state; other objects, if flaky or powdery, will, at least, be no worse for having been dipped in melted vaseline than they would be in any case, after transport.

No general hints can be usefully given about either the methods of discovering antiquities or those of detecting forgeries. It is not supposed that the travellers here addressed will undertake regular excavations. Should they propose to do so, they will need special training and much more elaborate instruction. Mr. Petrie's 'Methods and Aims' will supply much of the latter, but the tyro excavator will not have Mr. Petrie's success without serving a long apprenticeship.

The above hints will serve for the traveller who takes antiquities by the way and in the day's work, having other objects more in view. For him the following list of necessities will suffice :—

1. Long extension camera and all photographic requisites, including, if possible, a stand and frame for overhead photography (v. p. 52).

2. 'Squeeze' paper, brushes with hand-straps or curved handles, and tin cylinders for carrying the paper and moulds; heel-ball, sealing-wax, tin-foil, beeswax.

3. Planning and drawing outfit.

4. Notebooks ruled *en quadrille*, magnifying-glass and hand-mirror.

5. Small hammer and chisels for metal work, hydrochloric acid, ammoniac, emery-paper, tissue paper, burin, plate brushes, sheet zinc, vaseline, cotton-wool (*not* raw cotton-waste with hard seeds in it).

VIII.

MEDICAL HINTS.

By the late WILLIAM HENRY CROSSE, M.D.

Revised and brought up to date by ANDREW BALFOUR, C.B., C.M.G., M.D.

THE following hints, which were compiled by the late Dr. W. H. Crosse, formerly the experienced medical adviser of the Royal Niger Company, based upon previous editions of this work, have been edited so as to bring them up to date. A good deal remains as Dr. Crosse wrote it, but several sections have been almost entirely re-written, in order to bring them into line with modern views. New sections have been introduced and there have been numerous additions and corrections.

INTRODUCTION.

In the following pages the chief emphasis has been laid upon the care of the health in the tropics; but it must be remembered, that whilst by far the greater proportion of travellers go to the tropics, most of these hints for the preservation of health apply equally well for all climates.

Though many subjects have been briefly dealt with, certain matters have been rather more fully written up, such as the treatment of wounds. It is, in the author's opinion, so important that the traveller should thoroughly understand what is meant by 'surgical cleanliness' that the usual methods observed by surgeons to ensure it have been plainly set forth. The author, of course, understands that in many cases it would be quite impossible to carry out the instructions in every detail, but it is hoped that a thorough knowledge of the principles underlying the correct treatment of wounds will assist the traveller in

doing the best possible for his patient in any emergency, and under even the most unfavourable circumstances.

It is hardly necessary to observe that travellers in remote regions, and especially in tropical climates, are much more exposed to physical ills and diseases than most residents at home, and that they are more likely to be placed beyond the reach of skilled medical and surgical aid when it is most required. It is chiefly for the use of the non-professional traveller that the following pages have been written, and with this aim in view the symptoms and general treatment of the diseases and injuries with which he is most likely to be brought in contact are dealt with in simple, non-technical language.

Every traveller should supply himself with either Bernard Myer's 'Atlas of First Aid Treatment' or Hastings Young's 'First Aid to the Sick,' books of general utility. Travellers visiting countries with hot climates will find Garry's 'Some Factors Influencing Health in Tropical and Sub-tropical Climates' a useful book, despite a few errors, while the small 'Primer of Tropical Hygiene' by Colonel R. J. Blackham, is a valuable guide to things hygienic as is Professor Simpson's 'Maintenance of Health in the Tropics.'

A few books may be mentioned as specially suitable for those travelling in the countries with which they deal, such as 'Hints for Residents and Travellers in Persia' by A. R. Neligan, 'Health Preservation in West Africa' by J. C. Ryan, 'Hygiene and Disease in Palestine' by Masterman, and 'The Epidemics of Mauritius' by Anderson.

Those who read German will find the 'Gesundheitlicher Ratgeber für Auswanderer,' issued under the auspices of the Institut für Schiffs- und Tropenkrankheiten in Hamburg, of considerable service, and if they intend visiting South America it is worth noting that from the same source a series of small books to guide the traveller in different parts of that continent will soon be forthcoming. This series will also include works on Mexico, Angola, and Siberia. These German guides are obtainable from L. Friederichsen & Co., Hamburg.

Persons who intend to travel should undergo a thorough medical examination, in order to ascertain if they are likely to be able to stand the fatigues, exposures and privations to which they will probably be subjected.

Most people of good constitutions and regular temperate habits can, with care, maintain a good state of health in the tropics, and many of those

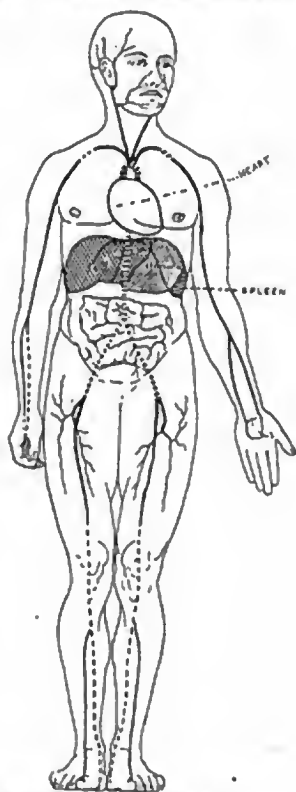


FIG. 1.—DIAGRAM SHOWING SOME OF THE PRINCIPAL ORGANS OF THE BODY, AND THE COURSE OF THE MAIN BLOOD-VESSELS.

who have been by no means strong at home are able with some extra caution to do well even in the hottest climates.

The intending traveller should attend a course of ambulance lectures in order to prepare himself for the responsibilities which he will have to undertake. As much time as possible should be devoted to discussing with some professional friend the uses, correct doses, and proper methods of prescribing and combining the drugs which are to be taken on the journey, and in becoming familiar with the position of the principal bones, vessels and other important structures of the human body.

A traveller should understand how to use the clinical thermometer, how to twist or tie a bleeding vessel, how to use the hypodermic syringe and the syphon stomach tube. He should learn how to cleanse a wound, how to treat a case of snake-bite, and should know the best way in which to set a broken limb. Such things are not easily learnt from books, and experience alone will give the necessary skill and confidence. Many valuable lives have been saved by travellers who have fairly mastered the rudiments of medical and surgical treatment, and who have been able in an emergency to give the necessary drugs, administer an antidote, or to stop severe bleeding.

The ideal traveller is a temperate man, with a sound constitution, a digestion like an ostrich, a good temper, and no race prejudices. He is capable of looking after details, e.g., seeing that drinking water has *really* been boiled, and is willing to take advice from those who have made journeys in countries similar to the one in which he is about to travel.

A traveller should be supplied with suitable housing, food and clothing, and should have a proper supply of medicines, dressings, and medical comforts.

In selecting the drugs with which the traveller should be provided before leaving home care should be taken to see that only reliable products be purchased. In the tropics, and in exploration generally, the medical outfit is subjected to very severe tests, and it is a mistaken policy to economise on medicines. The latter should be as portable as possible and be properly packed.

Risks to Health in a Tropical Climate.

Seeing that these hints will be chiefly required by travellers in tropical or sub-tropical climates, it may be well to indicate some of the chief risks

which are to be met with in warm climates, and the best methods of meeting them.

It will be noted that any detailed reference to questions of outfit, such as the supply of proper food or clothing, is omitted, as these matters have been fully dealt with in 'Hints on Outfit,' published by the Royal Geographical Society uniformly with this 'Hints to Travellers,' and it is understood that this work will be consulted by all who read those hints.

Chill.—The most prominent feature of a tropical climate is undoubtedly heat, and yet the greatest risk arises not so much from excessive high temperature as from a risk of chill, which is due mainly to the excessive perspiration which takes place. This must be guarded against by the use of proper clothing, the most important point being that the under-clothing should be partly of absorbent material. For general use cotton is best, and the vest or undershirt should in the tropics be of the Aertex Cellular type. It is a mistake to wear wool next the skin in hot countries, for it soon gets sodden with perspiration and is irritating. A light flannel shirt worn over the open cotton mesh is probably the best arrangement though a mixture of wool and cotton may be employed for the shirting. This question is fully dealt with in 'Hints on Outfit.' It is particularly important to avoid sudden changes of temperature, and if exposed to the cooling sea breeze, special care must be taken as to proper clothing. Parke laid great stress on the importance of avoiding chills, draughts, or wettings. He remarked "In crossing Equatorial Africa the Relief Expedition found that every wetting meant an attack of fever." The sea breeze, which is so refreshing and cool, by checking the perspiration, frequently acts as the exciting cause of an attack of fever. There is special liability to chill and subsequent fever when ascending an eminence, as the exertion causes profuse perspiration, and the cool breeze encountered on arrival at the top is very likely to produce ill-effects.

On completing a day's journey, the underclothing, at least, should be changed without delay, and the skin should be well dried by the free use of a rough towel. If at all possible a warm bath should be taken.

The cummerbund is a useful article of clothing, especially for men in the evening. It does away with the need for a waistcoat, which often proves hot and uncomfortable, and yet provides the necessary safeguard against chill to the abdominal organs.

A word as to the use of a flannel cholera belt, about which opinions differ. Experience in many tropical countries leads the writer to recommend its use at night, and at night only. Even so, it is unnecessary and uncomfortable in places where the nights are invariably hot and steamy, and is chiefly of value in dry, desert climates where there is a great difference between the day and night temperatures.

Effects of the Sun.—It is difficult to overestimate the importance of the protection of the head from the direct rays of the sun. It is best, where possible, to avoid going out in the heat of the day, but where this is necessary the head should be protected by a suitable helmet, which should be light in weight and colour, which should be ventilated, and which should have a good protection for the back of the head. A large green leaf inside the helmet might be an additional protection, and a sun umbrella should also be used wherever practicable. A helmet should as a rule be worn when going out during the day-time in the tropics. Sometimes, however, the helmet is found very troublesome, as, for example, by the sportsman in the bush. He may then have recourse to a double Terai hat, or even to an ordinary wide-brimmed felt hat provided he inserts a crumpled-up handkerchief in its crown. This will usually afford a reasonable protection.

Errors of Diet.—The lassitude which is often so much felt by Europeans resident in the tropics too frequently tempts them to the abuse of alcoholic stimulants and highly-spiced foods. The habit is a most pernicious one, for such indulgence is one of the most fruitful causes of the permanent ill-health so often wrongly attributed to the mere residence in a hot climate. There is no doubt that food should be taken with greater moderation in hot than in cold climates; heat-producing articles of diet, such as fat, should be taken in far smaller quantity, but an ample supply of vegetables is essential. The meals should never be heavy, especially during the heat of the day, and intervals of about four hours should always separate consecutive meals.

Cooking should always be conducted with great care in the tropics, for the stomach and liver are less able to bear any extra strain, such as would be induced by the attempt to digest imperfectly-cooked food. Parasites are often introduced into the system by insufficiently cooked food.

Natural milk must be boiled; condensed milk should be mixed with boiled water.

Excess in the use of alcoholic stimulants is one of the most fatal errors into which the tropical resident can fall, and their habitual use as beverages is totally unnecessary, tea, coffee and cocoa being the best beverages for ordinary use. A small supply of brandy, champagne, and port wine may be of service in certain cases of illness, but they are better regarded as belonging strictly to the medical equipment.

Avoid native drinks, as they will probably have been diluted with dirty water, or prepared in unclean vessels.

Great moderation in the use of alcohol is quite as necessary in arctic as in tropical climates. In the latter no alcohol should be taken till the sun has set, and even then the quantity should be strictly limited. There is no reason why a glass of light beer, a whisky and soda, or a little light wine should not be drunk with the evening meal. Alcohol taken at this time often promotes appetite and aids digestion, but alcohol between meals is bad, chiefly perhaps because the habit of exceeding the daily allowance is thereby apt to be engendered. It is largely a question of self-control, and it must be remembered that in the tropics self-control, so far as drinks are concerned, is very apt to weaken. Apart from the question of its habitual use alcohol is often of great service as a restorative, as, for example, after a fatiguing march, and especially if one has got wet and chilled. Champagne is possibly the best form to take on such occasions and it should be used as an *apéritif* or drunk along with food.

Risks due to Drinking Water.—The use of water for drinking purposes must be attended with great care in all tropical climates. As the water of the lakes, streams and pools of these countries usually contains a large proportion of impurities, and the germs or parasites of many diseases, it should be strained and subsequently boiled before being used.

As, however, it is not always possible or convenient to incur the delay of boiling the drinking water and allowing it to cool, it is advisable that a *reliable* filter should be taken.

Most filters—charcoal or otherwise—are merely death-traps, as the accumulation of germs and injurious matter within the filtering substance soon renders the water more dangerous than if unfiltered. There are, however, a few filters which, with ordinary care in cleansing, are in themselves efficient safeguards. The most highly recommended of these are the Pasteur Chamberland and the Doulton filters. In any case,

spare filtering candles should be taken, and these should be cleaned and boiled at least every three days. It is recommended that the filter-makers should be consulted immediately the probable requirements of any expedition are known. It should be remembered that no filter combines rapid delivery of water with efficient sterilization. A mistake commonly made is to boil water and then filter it. This should never be done.

The drinking of very cold water, to which there is great temptation when one is exhausted by prolonged heat and copious perspiration, should be carefully avoided; thirst often induces tropical residents to have recourse to iced water, which is always apt to be dangerous if taken when one is heated. The drinking of copious draughts of water is also a habit to be deprecated; it certainly weakens the muscular energy, and as the water is rapidly lost by perspiration, the feeling of exhaustion is increased. Hot or cold weak tea, without milk or sugar, is one of the least injurious of all beverages.

Precautions on the Voyage.

The traveller should endeavour to land in a perfectly healthy condition, and to this end he should on the voyage out take plenty of exercise, drink little or no alcohol, be moderate as to diet, and avoid much meat and rich dishes. Neglect of these obvious rules frequently ends in the traveller arriving in a flabby, bilious condition, in which state he is predisposed to attacks of malaria, dysentery, and other diseases.

Constipation is frequent at sea, and a scidlitz powder, a dose of fruit salt, or one or two cascara tabloids may be necessary. If constipation is severe, then one or two four-grain blue pills should be taken at bed-time, followed in the early morning by a scidlitz powder or some other saline aperient.

In order to avoid chill the traveller should be properly clothed during the evening or when there is a cool breeze, and should not stand in draughty doorways and passages on board. If he is proceeding to a country where there is endemic malaria he should begin his course of prophylactic quinine on ship-board, because even a single night spent ashore in a malarious locality may result in his acquiring infection. It

is therefore advisable to begin taking quinine in the manner described on p. 207 at least two days before arrival at the place of disembarkation.

What is true of the journey out is of even greater importance on the voyage home. There is a serious danger of illness owing to chills contracted on board ship when leaving a hot climate. Quinine should be systematically taken as recommended on p. 208.

GENERAL HINTS.

Never take a cold bath in the Tropics unless ordered to do so by a doctor.—In the case of persons who have already suffered from many attacks of fever, dysentery, or any disease of the liver or other important organs, warm bathing should alone be used. Bathing should never be resorted to during the period of digestion, i.e., three to four hours after meals. Wear warm clothes at night. Avoid the direct rays of the sun. Do not take too much animal food. Never begin work on an empty stomach. Never neglect a slight attack of fever or diarrhœa. Keep the bowels gently opened—once a day is quite enough—but avoid strong purgatives.

Vaccination.

It is essential that all the members of an expedition should be re-vaccinated if they have not suffered from small-pox or been vaccinated within two years. A proper supply of vaccine should be carried on the journey. Heat and bright sunlight are very detrimental to vaccine lymph. Hence the proper transport of such lymph in hot climates is a matter of great importance and by no means always easy to arrange. Where a thermos flask is available it may be used for storing and carrying the capillary tubes, or they may be wrapped up in green leaves and inserted into a hollow bamboo, the ends of which are closed with cotton wool.

Inoculation.

Owing to the prevalence of typhoid and paratyphoid fevers in hot countries it is essential that all persons, and more especially young adults, proceeding to tropical countries should undergo preventive

inoculation. Two injections of the so-called triple vaccine, at ten days' interval, are necessary, and both should be given shortly before leaving or, if arrangements can be made, one or both may be given on ship-board.

Isolation.

On the outbreak of an infectious complaint, such as small-pox (which is very common amongst negro carriers), the sufferer should be promptly isolated, and one or more attendants should take charge of the case and not be allowed to come to camp. It is wise to select as attendants those who have either had the disease, or who are protected (as by vaccination) against it.

In Nigeria it was found most convenient to build grass huts, which were burnt to the ground, together with the clothing and bedding of the patient and attendants, on the termination of the outbreak.

All vessels which are not destroyed must be boiled thoroughly. The motions, etc., of patients suffering from typhoid fever, cholera and dysentery should be disinfected, preferably by boiling, or, better still, destroyed by fire.

Transmission of Infection.

The traveller should remember that of late years the rôle of the healthy human "carrier" in the transmission of many communicable diseases has been established. This is true of such diseases as enteric fever and cholera, and when engaging servants, porters, and camp followers it is important to inquire into their previous history and, if necessary, to make certain that they do not harbour the specific organisms of such diseases.

DISEASES AND THEIR PREVENTION AND TREATMENT.

In the tropics, as elsewhere, the diseases to which the traveller is liable are due to widely differing causes, but in hot countries climatic conditions and parasites play a predominant part. Insects are very frequently to blame for the transference of the latter from the sick to the sound, both insects which are not themselves parasitic on man, e.g., the mosquito and the tsetse fly, and those which make man their host, e.g., lice and fleas.

It is useful for the traveller to bear diseases in mind from the standpoint of their etiology, as in this way he can more readily grasp the measures necessary for their prevention.

Accordingly, the following classification is given, merely as a guide, together with a few examples. The diseases themselves, for the sake of convenience of reference, are grouped alphabetically and are not classified in any way.

Table of Diseases Classified according to Etiology.

A.—Parasitic.

(i.) Due to "contact" either direct or through the agency of clothes, bedding, etc. Also due to direct inoculation through the skin or mucous membrane.

Examples: Many skin diseases, venereal diseases, small-pox, tetanus, and blood-poisoning (septicæmia).

(ii.) Due to "mouth to mouth" infection, through the agency of so-called "droplet" infection, expectoration, coughing, sneezing, etc.

Examples: Influenza, pneumonia, and pneumonic plague.

(iii.) Due to "droplet" infection, as above, or to infected scales from the skin, or to infected discharges from the nose, throat, or ear.

Examples: Measles, scarlet fever, small-pox, chicken-pox, diphtheria.

(iv.) Due to excremental infection through the agency of water, food, flies, fingers, dust, and soil.

Examples: Enteric (typhoid) fever, dysentery, diarrhœa, cholera, worm infections of many kinds.

(v.) Due to inoculation through the bites of insects, or the entry through skin abrasions of the infected excreta or infected crushed tissues of insects rubbed or scratched into these lesions.

Examples: Malaria, yellow fever, tick fever, sleeping sickness, filariasis, relapsing fever, typhus fever, bubonic plague.

(vi.) Due to invasion of the body by insects in their adult or larval stages.

Examples: Chigger, myiasis of various kinds.

B. Non-Parasitic.

(i.) Due to climatic conditions.

Examples: Heat stroke, diarrhœa in some instances, constipation in many cases, rheumatism, prickly heat, chilblains.

(ii.) Due to errors in diet.

Examples : Diarrhœa, beri-beri, scurvy, sprue(?).

(iii.) Due to poisons.

Examples : Scorpion sting, snake-bite, vegetable poisons.

(iv.) Miscellaneous.

Examples : Bed-sores, epilepsy, apoplexy, concussion of the brain, hay fever, and other conditions into the cause of which a mechanical element frequently enters.

It will be seen that some of these diseases, such as small-pox and diarrhœa, come under more than one heading, but this does not detract from the general utility of the above classification.

Bed-sore.

When a patient is confined to his bed for a long time it is necessary to support the lower part of the back on something soft, such as a pad of wool, or an extra pillow, in order to prevent the formation of a bed-sore; pillows should also be placed under the hips and heels.

To harden the skin it is well to rub it with alcohol or to treat it with oil or white of an egg three parts, and spirits one part; zinc ointment is also useful for this purpose.

Besides pressure, the most frequent cause of bed-sores is constant moisture from the passage of urine and motions and consequent damping of the sheets. Great care must be taken to thoroughly dry the back after any evacuation; the lower part of the back should be dusted with a powder of borio acid and zinc oxide.

If a bed-sore is present the patient should lie on a circular pad with a hole in the middle, to take pressure off the bed-sore. The sore should be thoroughly cleaned twice a day with some antiseptic lotion, such as chinosol or permanganate, and subsequently dressed with zinc ointment or vaselino.

If the bed-sore is on the back, the patient should lie if possible on each side alternately, to relieve the pressure.

Beri-beri.

In most cases this is a disease due to some deficiency in the dietary, which leads to a form of what is called peripheral neuritis. The name is possibly derived from a Cingalese word signifying "I cannot."

Symptoms.—Weakness of the legs and digestive troubles, abnormal sensations in the legs, frequently associated with swelling. The gait alters, and the arms and fingers may be affected. The condition is one of spreading paralysis, and in bad cases the heart is affected. In so-called wet beri-beri the patient becomes bloated as in dropsy, while in dry beri-beri he wastes away until he is little better than a skeleton. There is a "squatting test" which may enable one to recognize the disease at an early stage. The patient, with his hands on the top of his head, is unable to assume a squatting position and to rise from it unaided. If he is squatting and has to rise he accomplishes the act by climbing, as it were, up his own legs.

Prophylaxis.—Avoid overcrowding, as this seems in some cases to predispose to the disease. Give the yeast extract known as "Marmite," which is supplied in small cubes one-quarter ounce in weight. One should be taken twice a week, either alone or with bread or biscuit, or dissolved in warm water in the form of a soup. Lentils, other legumes, and oatmeal are useful. Eggs and fresh meat, when obtainable, are very valuable.

Treatment.—This is chiefly dietetic. Give yeast, two ounces daily, along with milk and sugar, or marmite in one-cube doses twice a day. Eggs are specially useful, while fresh milk, legumes, and nourishing soups are all indicated. Only small quantities of food should be given at a time. Rest in bed is very important, and the patient must be careful when he is allowed to get up owing to the danger of heart failure. Tonics are required during convalescence.

Blackwater Fever.

Blackwater fever is probably a pernicious complication of malarial fever, and derives its name from the colour of the urine. It must be remembered that dark-coloured urine is usual in all fevers; it is scanty during the height of the fever, especially if there is much sweating. If, however, it is obviously "bloody," the case is more grave, but as a rule it is only men broken down in health, and those who have resided in blackwater countries, e.g., Tropical Africa, parts of India, the West Indies, etc., for at least a year, especially those who have taken their prophylactic quinine irregularly, who suffer from this complication.

The reason for the occurrence of this condition is not fully known. Some have ascribed the symptoms entirely to the taking of quinine, but as the fever often occurs where no quinine has been given this is impossible. At the same time it appears likely that in certain cases of malaria, owing perhaps to some idiosyncrasy, quinine may help to bring on the symptoms. It is possible that chill occurring during the course of a fever may lead to the production of blackwater fever. Those who have had one attack are particularly liable to a recurrence, and after two consecutive attacks return to a temperate climate is required.

Symptoms.—In addition to the ordinary symptoms of malarial fever, the urine is dark, blood-like, and eventually porter-coloured; It is often scanty, and may become entirely suppressed. The skin is yellow, often a bright orange, there is frequent vomiting, often hiccough, and the vomited matter is usually of a green colour.

Prophylaxis.—With our present knowledge all that can be said is that malaria prophylaxis is also the method to prevent blackwater. Such prophylaxis, so far as quinine is concerned, must be properly carried out. Those who take quinine regularly, and in sufficient doses, do not contract blackwater fever. Chill and excesses of all kinds must be avoided.

Treatment.—Much the same treatment should be adopted as that fully described later for malaria. It is especially important to give an aperient at the beginning, and perhaps five grains of calomel is the best form. In every case, no matter how slight, it is essential to ensure, wherever possible, absolute rest in bed and skilled and careful nursing. If it can possibly be avoided a blackwater patient should never be moved from the place where he is taken ill. So long as he has a bed to lie on, a roof to cover him, and some sensible person to look after him who will carry out the doctor's orders, he should be treated on the spot. It is better, when it can be arranged, for the nurse to go to the patient than for the patient to come to the nurse.

The chief aim should be to support the strength by fluid nourishment, and to secure free action of the kidneys. The former should be maintained by fluid nourishment given in small quantities at frequent intervals, such as milk, Plasmon, Benger's food, Allenbury's foods, invalid Bovril, Brand's fever food, or Brand's essence, Maggi's consommé. A little Plasmon added to any of the meat preparations would be useful, while raisin tea is a valuable preparation.

In order to maintain free action of the kidneys, plenty of fluid should be given, such as barley-water made from Robinson's prepared barley, flavoured slightly with lime-juice or lemons. Weak tea is useful.

Diuretics which stimulate the kidneys must be avoided. The most effective method of flushing the kidneys is by giving saline injections by the bowel, but these, as a rule, can be administered only by a medical man or by a trained nurse under a doctor's supervision. It may, however, be stated that the amount usually given is six ounces of physiological salt solution (seven and a half grains of sodium chloride to the ounce of warm water). This is administered every hour, or even oftener, if necessary, in bad cases. In mild cases enemata every four or six hours will suffice. Other measures are the application of poultices or hot fomentations to the loins when suppression threatens, or when there is severe lumbar pain. Diaphoretics, so long as they do not depress the heart, are useful, and so is frequent sponging. Cold applications to the head and especially behind the ears alleviate headache.

The question of giving or of withholding quinine is an important one, but recent work on the subject indicates that in the absence of a medical man who can carry out blood examinations, it is advisable to give quinine as in the case of malaria.

Vomiting is often a serious complication, and the directions for its treatment, given under the head of malaria, should be carefully followed. If it cannot be speedily checked, feeding by the bowel must be carried out. See Nutrient Enema, p. 259.

So long as plenty of urine is passed and sufficient nourishment is taken there is little cause for anxiety, though wherever possible skilled assistance should be obtained at the earliest opportunity.

After an attack the patient is very weak and anaemic. He requires careful feeding and tonics, especially iron and arsenic. It is advisable that he should be invalided out of the endemic area, and he should be specially warned as to the danger of getting chilled or wet.

Bronchitis, or Inflammation of the Branches of the Windpipe.

Symptoms.—When bronchitis exists, there is a good deal of coughing—at first dry, but afterwards accompanied by frothy expectoration—with a sensation of rawness and tenderness at the upper part of the breastbone.

Treatment.—In the early stages of this condition, opium in some form or other will be found beneficial, and will often cut short an attack; for this purpose, ten grains of Dover's powder, or fifteen to twenty minims of chlorodyne, may be given every eight hours for twenty-four hours, and then be gradually diminished.

If the breathing is difficult, poultices should be applied to the chest and ipecacuanha, half to two grains, and ammonia, should be given three times a day. Later, stimulating expectorants, such as ammonium carbonate, should be administered.

Inhalation of steam often gives great relief; and the effect is much improved if thirty drops of Friar's balsam are added to a pint of hot water.

In tropical climates even an ordinary feverish cold very often tends to become malarial in character, therefore the use of quinine, in addition to the other treatment, is usually desirable, and five grains may be given thrice a day.

Burns and Scalds.

Where an extensive burn or scald has occurred, the clothing of the injured part should be removed by cutting, so as to cause as little irritation as possible. If the burn is only slight, the surface may be covered over with lint smeared with zinc or boric ointment, or oil. If there is much blistering, or the surface is charred, the skin should be cleaned up as well as possible with boric acid lotion, and hot fomentations of the same applied for twenty-four hours. After this, the burn may be dressed twice a day with boric ointment spread on lint. Great cleanliness is an important factor in the successful treatment of burns. In a severe burn, stimulants must be given, and the patient put to bed with hot-water bottles, and active treatment of the burn should be left till the patient has somewhat recovered from the shock.

When there is great pain, chlorodyne or laudanum in full doses will be required.

Cerebro-Spinal Fever.

This disease, also known as "spotted fever," is of special importance at the present time to the traveller in Central Africa, where it is very prevalent amongst the natives, especially in Uganda. It may, however, be encountered in all parts of the world, and in the tropics is very frequently a malady of the dusty months.

Causes.—The disease is very often transmitted from some carrier of

the causative organism, which occurs in the throat and nose, and is distributed by coughing, spitting, or sneezing. Infected material, such as handkerchiefs, may play a part, and the spread of the disease is greatly favoured by overcrowding, especially of sleeping quarters.

Symptoms.—In very acute cases the onset may be very sudden, the patient rapidly losing consciousness. As a rule the disease begins with headache, stiffness of the neck and chilly sensations. There may be vomiting, and the temperature is raised. The mind is often confused, and the patient may be delirious. The skin eruption, which occurs especially on the back and about the joints, and which is responsible for the name "spotted fever," is not very frequently seen, and can hardly ever be detected on a dark skin. In very bad cases there is violent delirium, laboured breathing, and a purulent discharge from the nostrils. One of the most characteristic features is retraction of the head, while a dislike to light is common.

Prophylaxis.—Avoid unnecessary fatigue and guard against overcrowding, faulty conditions of ventilation and those which tend to cause naso-pharyngeal catarrh. Persons who have been in contact with cases of the disease are probably well advised to wash out their noses with a dilute solution of permanganate of potash 1 in 1,000.

Treatment.—In the absence of a medical man this can merely be symptomatic. Hot baths relieve pain and restlessness. Ice to the head, antipyrin, caffeine or aspirin relieve headache, and sedatives may be given for the insomnia and delirium. The patient's mouth is foul, and should be carefully swabbed and kept clean.

Chicken-Pox.

In the tropics this disease is very largely one of adults.

Incubation period, a fortnight to three weeks. Rash appears first day.

Rash.—Pink spots, upon which blebs form after twelve to twenty-four hours. The blebs are at first transparent, but subsequently become yellowish, and after two to three days shrivel and separate, leaving a pink soar.

The symptoms are usually very mild, perhaps only slight fever, and possibly headache. The appearance of the rash is often the first symptom.

Treatment.—Isolation, and light diet. Bed may not be necessary.

Chilblains and Frostbite.

Chilblains are usually found on the fingers or toes—after exposure to severe cold—especially when tight gloves or boots have been worn. Certainly the best way to promote the formation of chilblains is to toast the semi-frozen fingers or toes at a fire or stove, before the circulation has been re-established.

When chilblains are threatened, the part should be well rubbed with snow, or with camphorated spirit. Sponging with hot vinegar is very effective. Chilblains are checked in the early stages by painting with tincture of iodine. Once they have developed a preparation containing carbolic acid is useful in allaying pain and causing them to disappear. Ulcerated chilblains should be dressed with borie ointment spread on lint.

Prolonged exposure to intense cold leads to development of frostbite. If the case is a bad one, or injudiciously treated, gangrene or death of the part always follows; if this is extensive, amputation may be necessary.

Frostbite should be treated first by vigorous friction with snow or pounded ice. The affected parts should then be well wrapped with cloths wet with cold water. It is extremely dangerous to bring them near a fire. Afterwards, the part should be wrapped in cotton-wool.

Cholera.

Cholera is a serious acute disease, characterised by frequent watery motions, vomiting, cramp and collapse.

Cause.—It is often contracted by drinking contaminated water.

Research has shown the importance of the cholera "carrier," that is to say the person, usually a native, who harbours in his bowel the specific organism of the disease. He may be perfectly healthy and yet be able to transmit cholera to other people by infecting water or food. The rôle of flies, infected clothes and rags, and faulty conservancy methods must be kept in mind.

Symptoms.—Giddiness, faintness, persistent vomiting and diarrhoea, great prostration, feeble pulse, cold perspiration, colic, intense thirst, and constant desire to pass urine. The vomit and motions rapidly become like rice-water in appearance, and the urine is more or less suppressed. There are severe cramps in the legs, belly, and other parts of the body.

If then the pulse becomes weak, the temperature low, and the countenance dusky, the patient will probably sink. On the other hand, reaction may set in, all the symptoms abating, and the pulse, temperature, and colour becoming natural; the water is passed more freely, vomiting is less frequent, and the motions become more natural in colour.

Prophylaxis.—Anti-choleraic inoculations are now practised. They not only afford a considerable degree of protection but lessen the risk of a fatal issue in the inoculated. Hence it is advisable to be vaccinated against cholera whenever there is risk of infection. The inoculation must be repeated after the lapse of four months if the epidemic still persists, as the protection afforded is only temporary. Persons travelling in regions where cholera is present in an endemic form should take a little lactic acid in tea, or add a little vinegar or thirty drops of dilute hydrochloric acid to every ounce of drinking water.

At times of epidemic prevalence it is essential that all water should be boiled. The practice of hand-shaking should be discouraged, indigestible diet should be avoided, and raw fruit, raw vegetables, and meat jellies should not be eaten. Lettuces and celery, being moist and eaten uncooked, are specially dangerous. Patients and contact cases must be isolated, and the former should be protected from flies. It is very necessary to maintain a strict supervision of cooks and cooking arrangements. All kitchen cloths should be washed in permanganate solution or boiled. Milk should always be boiled.

Cholera stools may be disinfected by adding a five per cent. cresol solution to them and allowing it to remain in contact with the stool for at least one hour. Quicklime is excellent as a disinfectant. Add together equal parts of fresh quicklime and water, dilute with three times as much water as previously used, add a quantity of this slaked lime equal to the amount of stool to be disinfected and allow it to remain in contact with the stool for one hour. When the ground has been fouled by dejecta or vomit, disinfect with cresol, or rake hot ashes over it or pour kerosene oil upon it and set the latter alight. Cholera-soiled clothing, bed linen and blankets should be soaked in a two and a half per cent. cresol solution.

Treatment.—Isolate the patient, keep him warm, and give ice to suck. Apply hot bottle to the feet, and mustard leaves to the pit of the stomach.

It is advisable to clear the bowel of irritating material at the outset by giving half an ounce of castor oil with a teaspoonful of brandy. Drugs are of little use in cholera, but some like to give one drop of carbolic acid, together with twenty drops of spirit of camphor (or peppermint, or a little brandy), five grains of bismuth, and ten grains of soda, suspended in one ounce of gum water, every four hours. Chlorodyne may be given to allay severe pain.

Even in the mildest cases absolute rest in bed is essential, and a warm bedpan should be provided.

In the early stages no food at all should be given, but plenty of fluid should be allowed, though it must be administered only in sips. Stimulants may be necessary. Later on fluid food such as milk should be given carefully, and the quantity gradually increased.

The special treatment for cholera can only be carried out by a medical man, and recourse should be had to his help at the earliest possible moment, as everything depends upon immediate treatment. If, after the acute symptoms subside, diarrhoea continues a dose of bismuth is often useful.

Colic.

This is the name given to the well-known severe twisting or griping pains in the belly, usually due to excessive flatulence, and resulting from constipation, or some error of diet.

Treatment.—Hot fomentations should be applied to the belly, or better still, the Instra, which is the best means of applying continuous heat to any part of the body. A turpentine enema (a tablespoonful to a pint of warm water) will nearly always cut short the symptoms; in the absence of turpentine, give warm water alone. A full dose of opium (20 minims) should also be given if the pain is severe, preferably in a tablespoonful of castor oil.

Bicarbonate of soda, carbonate of ammonia and ginger should be freely given in full doses, and the bowels should be well opened as soon as the severe pain has passed off.

Concussion of the Brain.

This term is applied to the partial suspension of the functions of the brain, produced by the severe shaking of its substance by a fall or blow.

Symptoms.—At first the patient lies in an unconscious condition, skin

cold and clammy, pulse and breathing very feeble, and temperature extremely low; he can be slightly roused by shouting; he cries out if he is moved, or when painful applications are made, but quickly relapses into insensibility. The stage of unconsciousness may pass off almost at once, it may be prolonged for hours or days, or the patient may never recover from it. The second stage—that of reaction—is marked by returning consciousness and frequently by vomiting, the skin becomes warm, and gradually the patient recovers; on the other hand, inflammation of the brain may set in, or he may again become unconscious and die.

Treatment.—Keep the patient perfectly quiet in bed, in a darkened room, give a milk diet, and if he is much excited, apply cold cloths or an ice-bag to the head. If there is much prostration apply a hot-water bottle, and restore the circulation by rubbing the limbs. When reaction sets in, give five grains of calomel.

Stimulants should be avoided in cases of concussion of the brain, unless the collapse is very alarming (when ammonia should be given), as they tend to cause too violent reaction, which might be followed by inflammation of the brain and its coverings.

Constipation.

This condition is very frequent in tropical climates, where it is associated with sluggishness of the liver. One of the best remedies is the two-grain tablet of cascara, of which one may be taken three times a day. Rhubarb is also a very useful drug. In addition to this, an occasional dose of a saline purge should be used, or a large enema of soap and water may be given. Five grains of blue pill or three grains of calomel will be found to act as a very efficient aperient, especially if followed in about six hours by a saline such as fruit salt. Castor oil is a valuable remedy, but it must be remembered that in the tropics its effects are sometimes rather severely felt, and hence it is well to give it in somewhat smaller doses than those usually employed in temperate climates. Three-quarters of an ounce may be given where an ounce would otherwise be employed.

As a rule, the general health of people suffering from simple constipation is not seriously affected.

In cases of chronic constipation one of the anti-constipation products, otherwise known as the Aloin Co., given three times a day and gradually reduced, will be found useful.

In most acute diseases, such as malaria, pneumonia, etc., if constipation is present, it should be treated at once by means of suitable aperients.

Note.—In peritonitis, i.e., inflammation of the bowels, hernia, and in some cases of typhoid, constipation is a leading symptom, and is accompanied by severe pain in the belly. On no account should an aperient be given by the mouth in these cases. If it is necessary to clear the bowels, this should be done by means of an enema.

Coryza, or Cold in the Head.

When a cold is confined to the head it can usually be cut short by retiring to bed early, taking a ten-grain dose of Dover's powder, followed by hot drinks to encourage the perspiration which the action of this drug produces, together with the use of as many additional bed-clothes as can be borne. Care must be taken to avoid chill on the following morning. Once it is established the condition is difficult to cure, but marked relief will often be afforded by washing out the nose with a solution made from naso-pharyngeal products. In fact, a simple nasal glass douche should form part of the traveller's outfit, at least, if he is liable to bad colds in the head. In tropical regions five grains of quinine should be added to the dose of Dover's powder. When there is a liability to colds in the head the use of preventive vaccines is recommended, but these should not be employed without the advice of a medical man.

Cystitis, or Inflammation of the Bladder.

Causes.—Injury or the result of operations, extension of inflammations such as gonorrhoea, retention and decomposition of urine; debilitated or gouty persons are especially liable to this affection.

Symptoms.—Intense pain in the lower part of the belly, and in the crutch, continual desire to pass water, with frequent passage of small quantities. The urine is scanty, high-coloured, foul-smelling, and occasionally blood-stained, and there may be some fever.

Treatment.—Hot baths, leeches, or fomentations to the crutch, and

a sedative, such as opium (preferably given by the bowel), will be required. If the disease continues the bladder should be washed out through a catheter with weak boric acid solution, five grains to the ounce, or chinocol (1 in 2000), twice a day. Urotropin, ten grains, and copaliba or sandal-wood oil in ten-drop doses.

The diet should be restricted to milk.

Dengue.

This disease, also known as dandy fever and break-bone fever, occurs in many parts of the world, and it is most common along littorals, probably because the *Stegomyia* mosquito which carries the infection is usually numerous in sea-coast places.

Cause.—The organism of dengue fever is unknown, but the infection has been proved to be carried by at least one species of mosquito.

Symptoms.—The incubation period varies from about five to ten days. The onset is very sudden, the temperature rising rapidly. Within an hour or two an initial rash appears, which varies in appearance and is transient. The patient suffers from severe headache and pain in the joints and back. Indeed, the condition closely resembles a sharp attack of influenza, but, as a rule, there are no signs of coryza. The eyes are very painful and insomnia is present. The high temperature lasts for three or four days, then drops, continues low from twelve hours to three days and rises again sharply. During the interval the patient feels better but the symptoms start again when the temperature rises for the second time. In the second stage the true rash of dengue appears, which is rather like that of measles, and it is followed by desquamation of the skin. The disease, though often causing great weakness, is very rarely fatal.

Prophylaxis.—Protect against mosquito bites by using a proper mosquito net or by employing mosquito repellents such as "sketo-fax."

Treatment.—Light diet, rest in bed, phenacetin and aspirin for the relief of pain and headache. Cold sponging helps the febrile condition and the insomnia. During convalescence there is often much depression, and the patient benefits by being ordered tonics and a sound wine.

Diarrhœa.

Diarrhœa, or looseness of the bowels, is one of the most common and one of the most serious ailments of the tropics, and should never be neglected. In many cases it is a sign of enteric fever, dysentery, cholera, or sprue, the symptoms of which are given below. Ordinary attacks are usually due to the presence of some irritant in the bowels, such as irritating sand, bad food, unripe fruit, or other poisonous material. Amongst African and other natives diarrhœa is often due to a faulty or ill-cooked dietary. The importance of flies in fouling food should not be overlooked.

Treatment.—Begin the treatment by administering castor oil, fruit salt, cascara, or other mild aperient, to clear out the cause of the diarrhœa. If castor oil is used the following note as to its administration is likely to be of service. Place an ounce of brandy in a glass or eup. Carefully pour the oil into the centre of the brandy and then add one ounce of water. The mass of oil will then resemble the yolk of an egg enclosed in the white. Lime juice may be used instead of brandy. Failing these, black coffee helps to cover the taste and "feel" of the oil. Sometimes three grains of calomel with fifteen grains of sodium bicarbonate act better than castor oil. A warm-water enema of about a pint is useful.

If the diarrhœa continues, give chlorodyne (20 minims) and tincture of ginger (10 minims) in an ounce of water two or three times a day.

This treatment should not be persisted in for more than two days.

If the diarrhœa is persistent, an astringent is needed: five grains of tannin, or two or three grains of sulphate of iron may be given three times a day. Ten grains of quinine should be given each day.

All food should be semi-solid and tepid; milk diet, as recommended below for enteric fever, is the safest food, but soup thickened with rice or arrowroot is good. The patient should keep in bed and wear a flannel band round the belly. Sometimes in the tropics, as the result of excessive purgation, diarrhœa is very acute and may be alarming. In such cases a hot bath, stimulants and the administration of astringents are indicated.

If the trouble continues for more than a few days it is probably due to dysentery, or typhoid.

Diphtheria.

Diphtheria is an acute infectious disease, the essential feature of which is a peculiar inflammation of the lining membrane of the mouth, nose, throat, and windpipe, characterised by the formation of a membrane upon the inflamed surface. Diphtheria occurs in the tropics but happily does not spread much in hot countries.

Causes.—It may be contracted from some person suffering from the disease, from a healthy "carrier" harbouring the specific micro-organism (*Bacillus diphtherie*) in his throat or nose, or from infected milk, etc.

As the disease is a very grave one, and skilled treatment is often an absolute necessity, measures should be immediately taken to summon medical assistance on the first appearance of diphtheria, or the patient should be sent as speedily as possible to a place where medical aid is likely to be obtained; for if the breathing becomes so difficult that the patient gets blue in the face, an operation for opening the windpipe will be necessary.

Incubation period, two to six days or even longer.

Symptoms.—Headache, discomfort, loss of appetite, sore throat, and sickness, with swelling of the glands at the angle of the jaw. On examination the palate and tonsils are seen to be swollen, with a white deposit of membrane upon the surface. The membrane may be thick and tough, and if stripped off will leave numerous small bleeding points.

The temperature may run up, and is irregular in type. The pulse is rapid and feeble, and the bodily strength is quickly lost.

If the nose be affected there is copious discharge from the nostrils, with difficulty of breathing and much discomfort. If the windpipe is affected the voice will become hoarse or absent, and there will be greater difficulty in breathing, accompanied by a loud crowing noise.

Diphtheria may be accompanied by cough and pneumonia.

Treatment.—Isolation. Bed. If diphtheria antitoxin is obtainable, it should be administered at the earliest opportunity, but this should only be carried out by a doctor.

Nourishing foods and stimulants should be given frequently in small quantities. The throat should be thoroughly and frequently washed

out with chinisol (1 in 1000) or other antiseptic lotion. If the difficulty in breathing is marked, warm baths should be given at intervals of about four hours. A steam kettle should be placed near the bed. The expulsion of the membrane may often be aided and great relief afforded by the administration of emetics, such as ipecacuanha, but these must be given with care owing to the risk of heart failure.

Complications.—Diphtheria may be followed by paralysis of the wind-pipe with loss of voice, or paralysis of other parts of the body, therefore great care should be taken not to allow convalescents to get up too soon, no matter how well they may appear.

Dysentery.

This disease, which is due to an inflammatory condition limited as a rule to the lower or large bowel, may be the result of a variety of causes, but there are two chief types which must be clearly distinguished: (1) Amœbic dysentery, due to a protozoon or animal organism, (2) Bacillary dysentery, caused by certain micro-organisms belonging to the vegetable world.

Amœbic dysentery is much more of a tropical complaint than is bacillary dysentery, but the latter is also common both in tropical and temperate climates. Both forms are transmitted in much the same way and their symptoms are very similar. Hence from the layman's point of view no good purpose is served by considering them separately, at least so far as methods of transmission and symptoms go. The treatment of the two forms, however, differs, and to carry out such treatment effectively medical skill is required.

Causes.—Dysentery is conveyed by impure drinking water, contaminated food, infested flies, and possibly also by infected dust. In both forms, but especially in the amœbic variety, the so-called "carrier" plays an important part, because in the latter case the organism produces cysts which are passed by the bowel, and these cysts are frequently found in the dejecta of persons who have suffered from amœbic dysentery and who are either convalescent or possibly in quite good health. If these cysts find their way into food or water and are then swallowed they are capable of developing in the human intestine

and producing dysentery. Carriers are also met with in the bacillary form of the disease. Dysentery may be provoked by chills, general debility and exhausting conditions, such as chronic malaria.

Symptoms.—Diarrhœa with pains in the belly, straining and frequent desire to go to stool. The motions soon become small in amount, slimy, lose their natural colour, and contain more or less blood; when there is ulceration of the coats of the bowel, the motions are extremely offensive, and bleeding may be very free. There is heat, tenderness, and bearing down about the outlet of the bowel, with considerable prostration and probably some fever; there is frequently a constant desire to pass water. All these symptoms may be due to severe ordinary diarrhœa; but in the tropics it is best to treat them as if they were dysenteric. Some guide may be obtained as to the form of dysentery from which the patient is suffering by taking his temperature. As a rule there is little or no fever associated with the amœbic form, while in the case of the bacillary type the temperature is always raised and in severe cases may be considerably elevated. It is in this form that the small intestine is apt to become involved and then the condition is more serious.

One help in diagnosis, though not a very reliable one, is the character of the stool. In amœbic dysentery the blood is apt to be mixed with the dejecta and to be dark in colour, while the whole mass looks brown or greyish green. The stool of bacillary dysentery, on the other hand, has a whitish appearance, the blood in it is bright coloured and is often in the form of streaks or spots. The amœbic form is apt, if not promptly and efficiently treated, to be followed by inflammation of the liver, which may go on to liver abscess.

Prophylaxis.—Avoid chill and debilitating causes of all kinds. In countries where there is a great difference between the day and the night temperature wear a cholera belt. Carefully protect food and water from contamination of any kind, and especially from flies. Doubtful water should be boiled or rendered sterile by some chemical method. All milk should be boiled. Care should be taken not to employ as cooks natives who have recently suffered from dysentery, and scrupulous cleanliness should be observed in the preparation of food. Unripe fruit and other materials apt to cause diarrhœa should be avoided. Camp conservancy methods should be carried out on approved sanitary principles which prevent the access of flies to human excre-

ment and prevent the latter from being disseminated by wind or in any other way. All dysenteric stools should be carefully disinfected or burnt.

Treatment.—The general treatment is common to both forms, the essentials being rest, warmth and suitable food. Put the patient to bed, apply a cholera belt and get the bowels open by an initial dose of castor oil. If there is much pain ten drops of tincture of opium may be added to the oil. The usual dose of the oil is an ounce, but if the patient is feeble or exhausted half an ounce will be sufficient.

As regards diet do not give any milk at first, and indeed if the case is recognized as being one of bacillary dysentery milk should not be given at all as it tends to favour putrefaction. Albumin water, rice water, chicken broth are required during the first twenty-four hours. Thereafter in the amœbic form milk diluted with barley water or with citrate of soda (three grains to the ounce) can be given. Soups are often useful, and at a later period custard, arrowroot and jellies are indicated. In the bacillary type arrowroot, meat and fruit jellies and beef-tea can be given from the outset. In both types the food should be given in small quantities frequently, and it should be neither too hot nor too cold. Alcohol is deleterious.

Fortunately we now have a specific drug for treating amœbic dysentery and that is emetine, which is the active principle of ipecacuanha. It is best given in the form of emetine bismuthous iodide, which is supplied in capsules and the dose of which is three grains per day for twelve consecutive days. The dose is best given in the evening along with a cup of hot tea on a full stomach when the patient is in bed. If it causes much vomiting it is well to give ten or fifteen drops of tincture of opium before administering the emetine. The latter can also be given by subcutaneous injection, but this method of treatment should only be carried out by a physician. Where emetine is not available ipecacuanha itself may be used and is given as follows:—

Treatment by Ipecacuanha.—When the bowels have been opened, give twenty grains of ipecacuanha, either solid or mixed with a wineglass of water, or less; arrowroot, starch, or gum-water, which will help to suspend the drug. Of course, ipecacuanha will act more quickly if it can be taken suspended in a liquid, instead of in the solid form. To prevent vomiting, put a mustard leaf to the pit of the stomach. Absolute

quiet must now be observed; darken the room, and allow no moving in bed or talking. Withhold food and liquid for at least two hours if possible, but if there is much thirst, teaspoonful doses of water may be given.

If there is no vomiting for an hour, probably a good part of the ipecacuanha has been digested; if it has been vomited, wait for half-an-hour, and then give another full dose. If vomited again, wait for two hours, and give twenty drops of chlorodyne, followed by twenty grains of ipecacuanha; the chlorodyne is to quiet the stomach, enabling it to retain the ipecacuanha. In about twelve hours from the first dose, repeat it in exactly the same way. If thirty grains are too much at a time, give twenty, three times a day, for not less than sixty grains should be given in twenty-four hours. The drug is not a dangerous one, and, if the patient can take it, too much can hardly be given. Between the doses feed the patient, giving but little at a time. If the ipecacuanha is going to do good, marked improvement should be apparent in four or five days; failure of the drug is often due to its not being given or retained in sufficiently large quantities.

In addition to the emetine or ipecacuanha treatment it is well, save in mild or trivial cases, to give a saline mixture once a day, for example one ounce of sodium or magnesium sulphate. Other methods which are helpful are enemata of warm water, hot hip baths, or a soothing injection made by soaking an ounce of linseed for several hours in two pints of warm water. Sedatives, such as laudanum or chlorodyne, should be used only in cases where there is severe pain, sickness and great distress. The full dose in ordinary cases is twenty drops three times a day, but if less is sufficient so much the better, and it is advisable to avoid these remedies wherever possible.

The object of treatment is not to block up the bowel—as might be done by giving large doses of opium or tannin—it is to cure the disease of which the looseness is only one symptom. The most favourable sign during an attack is a return of the colouring matter to the motions; this shows that the liver is again acting, and that the treatment is doing good. With the return of colour (which at first may be intermittent), the other symptoms, such as pain and bloody discharge, will abate, and the motions will become more solid and healthy.

In dysentery, as in severe diarrhoea, the patient should *not* be allowed

to get up to stool. A box out across obliquely will make a rough slipper bed-pan; put sand in it, and pad the edges.

In bacillary dysentery emetine is nearly or quite useless, and recourse should be had to a saline treatment. A mixture containing sixty grains of sodium or magnesium sulphate, fifteen drops of dilute sulphuric acid, and five drops of tincture of ginger can be given in half an ounce of peppermint water, if necessary, every two hours at first, and then every four or six hours, until the stools are watery and bile-stained. An alternative method of treatment, but one which is not so satisfactory, is to give half-grain doses of calomel every hour for twelve hours on three successive days. The patient must, however, be watched for such symptoms as tenderness of the gums, salivation (i.e., great increase of the saliva), and a metallic taste in the mouth. Should such symptoms arise the doses must be reduced or the drug discontinued.

The general treatment is the same as that for amoebic dysentery. As colic is often very severe, turpentine stupes or poultices to the abdomen are often indicated.

A specific anti-dysenteric serum is now employed in cases of bacillary dysentery, but its administration requires medical skill.

When the acute dysenteric attack is over, bismuth may be given, and various astringent enemata may be tried, but these should not be administered in the absence of a physician. A simple form of enema, however, is one containing a teaspoonful of alum or ten grains of sulphate of iron to the pint.

Enteric or Typhoid Fever, including the Paratyphoid Fevers.

It is impossible to give a full account of the enteric fevers here, and moreover the presence of a medical man, still more of a good nurse, is absolutely necessary for their proper treatment. The chief early symptoms, however, will be given, and a few hints as to their treatment. For all practical purposes paratyphoid fever may be considered as a mild variety of typhoid.

The disease is characterised by ulceration of the small bowel, with continued high fever, and is usually accompanied by diarrhoea.

Causes.—It is generally caused by the drinking of impure water, but

may also be transmitted by all the causes operative in the case of dysentery (*see* p. 185).

The incubation period is from ten to fifteen days.

Symptoms.—The early symptoms of the disease are often so slight that the patient will not believe he is really ill; he may just feel out of sorts, or complain of headache, but still go about his work. There may be diarrhœa, or occasionally constipation. After five or six days the patient is generally compelled to give up and go to bed, headache or diarrhœa, or both, being the chief complaint. The temperature goes up in a characteristic manner, rising a little more every evening till it eventually reaches 103° or 104° F. There may be some cough, and often this symptom is a very troublesome one.

The belly is usually distended and slightly tender, and there may or may not be the characteristic typhoid rash, consisting of rose-pink circular, slightly raised spots, about the size of a large pin's head. They occur chiefly on the chest and abdomen, and come out on successive days, often only three or four at a time. These spots are frequently absent, and then one must be guided by the presence of other symptoms. They are difficult to be seen upon a dark skin.

The possibility of enteric fever should always be remembered in cases where there is constant fever, unaccompanied by any definite symptoms, such as the recurrent shiverings of malaria, or the spitting of blood in pneumonia.

Prophylaxis.—As for dysentery (*see* p. 186). Preventive inoculation is very important and confers immunity for a considerable period (*see* "Inoculation," p. 168).

Treatment.—Absolute quiet in bed. If constipated, bowels should be kept open by soap and water enema only.

Milk only (three to four pints daily) should be given during the whole course of the illness and till ten days after the temperature has descended to, and remained, normal. Stimulants, if pulse is feeble and rapid; opium only if there is much pain. If bleeding occurs from the bowel, an ice poultice or cold-water cloths should be applied to the belly; ice may be given to suck; opium and an astringent, such as tannin, administered by the mouth, or an opium enema be given. Milk should be given in small quantities only, and to each half-pint five grains of bicarbonate of soda should be added.

The motions must be burned, or carefully disinfected.

Epilepsy.

Symptoms.—This is the most common form of fits. There are three stages. *1st stage*—The patient falls down completely unconscious and without warning, the face is pale, the limbs become stiff and rigid, and the breathing ceases. *2nd stage*—Convulsive movements take place, the tongue being often bitten, the breathing becomes heavy and laboured, and the motions may be passed unconsciously. *3rd stage*—A confused mental condition, sometimes acute mania, usually sleepy for some time. In some cases the fit may only last a few minutes. They almost always recur.

Treatment.—During the attack nothing can be done beyond loosening all tight clothing, and gently preventing the sufferer from injuring himself in his struggles. It is especially important to keep the teeth apart with a piece of cork or rubber to prevent the tongue from being bitten.

Bromide of potassium (ten to twenty grains) may be given three times a day as a preventive.

Faintness.

Bending the head firmly down between the knees is the best and most rapid way of dealing with an attack. Another method is to lay the patient on a couch, loosen any clothing which is round the neck, bathe his face and arms with cold water, and fan him vigorously. Give three grains of carbonate of ammonia in an ounce of water. Alcohol may be given if the pulse is very weak, but sal volatile or carbonate of ammonia is more efficacious.

Filaria.

This term connotes several pathogenic conditions, but the most important form of filariasis in man is that due to a small blood-worm which is conveyed by the bite of one or other species of mosquito. The most important symptom of filariasis is the condition known as elephantiasis, but the presence of filaria in the blood also causes a febrile state and various other symptoms which need not be detailed.

Prophylaxis.—Protect from the bites of mosquitoes, especially those which breed in the vicinity of human habitations. The most effective method of doing this is the careful use of a mosquito net.

Gonorrhœa.

Gonorrhœa, or clap, is an acute inflammation of the urethra or pipe, attended with a discharge of more or less matter. It is nearly always due to direct contagion.

Symptoms.—At first there is some itching about the end of the pipe, which is followed by a yellowish-white discharge. This lasts from three to five days. Then great pain is noticed on passing water, and the discharge becomes thick and yellowish-green in colour, with redness and swelling about the lips of the opening of the pipe. After a time the pain on making water disappears, and the discharge becomes thin and watery, a condition known as "gleet."

Treatment.—Forbid alcohol in any form. Give large quantities of liquid—water, weak tea, or milk—to thoroughly flush the system. Light diet and as complete rest as possible. Keep bowels well open with saline and other purges. Give sandal-wood oil or copaiba, twenty drops three times a day, and urotropin, ten grains twice a day.

If there is much pain in the acute stage, a mixture containing fifteen grains of bicarbonate of soda, and five drops of chlorodyne or laudanum, in an ounce of water, may be given twice a day. Except in very acute cases the pipe should be syringed out with a very weak solution of permanganate of potash, or better, a solution of protargol (quarter to two per cent.); later on, a lotion containing four grains of sulphate of zinc to one ounce of water may be used as an injection.

If the glands in the groin become tender and inflamed, they should be painted with tincture of iodine. If, in spite of this, the pain and swelling increase, they should be poulticed frequently, and treated as ordinary abscesses.

Hay Fever.

This is a very severe catarrh which attacks certain individuals yearly, when grasses and other plants are flowering. It is most probably due to the irritation of the nose by pollen grains in the air.

Treatment.—Exposure to the irritating substances which are known to provoke an attack should be avoided.

The nose may be syringed out with a lotion containing boric acid and bicarbonate of soda (five grains of each in four ounces of water), or one

containing bicarbonate of soda and salt (five grains of each in four ounces of water), to which has been added two to four drops of carbolio acid. The interior of the nostrils may be anointed with vaseline. Menthol suuff is of great value. A substance called "Pollautin" has a specific action in many cases, but it should be employed only under medical supervision.

Influenza.

Influenza has been introduced into many tropical countries, in which it has spread rapidly and caused in many instances a very heavy mortality. The actual cause of the disease is still a matter of dispute, but there can be no doubt that it is chiefly spread by personal contact.

Symptoms.—What may be called the respiratory type is pretty well known to everyone, but it should not be forgotten that sometimes the main stress of the disease falls either on the alimentary or the nervous system, while there is also a type of what is known as febrile influenza in which the heat-regulating centre is greatly upset. In this latter form the temperature may be intermittent and it is then apt to be mistaken for malaria.

The respiratory type is the most important. Its incubation period is short, one or two days. The onset is sudden and is characterized by shivering, pains in the back and limbs, severe headache and a feeling of malaise. The patient may be giddy and suddenly collapse, his throat is often dry and sore and he has an irritating cough. His temperature rises and runs up to 102° to 104° F. His face becomes flushed, his eyes reddened and his tongue is furred. Constipation is common. Uncomplicated influenza, if promptly attended to, is not a very serious disease, and improvement usually sets in about the third day. The most serious complication of influenza is bronchial pneumonia, and in some forms of the disease the heart is very apt to be affected.

Prophylaxis.—Isolation of cases; free ventilation; treat patients as much as possible in the open air. Nurses and those attending the sick should be careful about contracting infection from the patient's invisible mouth spray. Indeed in some epidemics the use of face masks has been recommended.

Treatment.—Rest in bed as soon as possible; free purgation at the outset; an early dose of twenty to thirty drops of laudanum (Tinet.

opii) is often very beneficial but the drug must be administered with care. Aspirin in ten-grain doses thrice daily frequently relieves the more urgent symptoms. In cases where there is vomiting and collapse with high temperature a dose of fifteen grains of aspirin with half to one ounce of brandy and three drachms of liquor ammon. acetat. may act like a charm. According to our present knowledge, however, it would seem that drugs are of little use in influenza, and that the important thing is to ensure good nursing and to keep up the patient's strength. Quinine in effervescent form is very useful for convalescent cases.

Insect Pests.

(See also *Myiasis and Skin Diseases.*)

These are best divided into the Winged and Wingless forms. Of the winged pests *Mosquitoes* are undoubtedly the most important in the tropics, as they are known to transmit such diseases as malaria, yellow fever, dengue fever and filariasis. The anopheline mosquitoes are those responsible for transmitting malaria, and they can easily be recognized by the facts that their wings are usually spotted and that they appear as it were to stand on their heads when resting on any flat surface. The culicino mosquitoes, which include *Stegomyia fasciata*, the carrier of yellow fever, do not as a rule have spotted wings and they rest parallel to the surface on which they alight. There are also marked differences in the water stages of these insects which cannot, however, be here considered.

The best way of protecting oneself against mosquitoes is the proper use of an effective mosquito net, the mesh of which should contain at least sixteen holes to the linear inch. Mosquito boots or buskins are also useful, and in certain places hoods for the face and neck, such as the "Mosquinetto" variety, will be found of value.

Repellent substances applied to the skin may also be employed. Cassia oil, with brown oil of camphor in vaseline, is useful. Vermijelli, containing a little citronella oil, is fairly effective but is not so pleasant to use. The irritating effect of mosquito bites may be diminished by the application of tincture of iodine. The same measures are effective in the case of some of the biting midges.

The insects generally known as *Sandflies* are really owl midges or

moth flies, tiny and hairy insects which have been proved to transmit sandfly fever (*see* page 221). These flies breed in damp places where there is rotting vegetation, dark and damp cellars, cracks and fissures in the soil, tunnels, etc., and they are often very troublesome. The repellents mentioned above may be used to drive them away, as may eucalyptus oil, camphor and tobacco smoke. The ordinary mosquito net is useless against their attacks, and one containing twenty-two holes to the linear inch is required.

Buffalo gnats, which are often called sandflies, are insects which breed in running water and amongst cataracts and rapids. They are formidable biters although they are not known to cause any disease. The same protective measures are indicated in their case as in that of owl midges.

House Flies.—There are several species of these. They are definitely known to distribute certain harmful bacteria and protozoa and to contaminate food by carrying the organisms on their bodies, wings and legs, or depositing them by regurgitation or in their droppings. Hence it is very important to protect all food and drink from flies and to destroy these insects wherever possible. The subject of their destruction is too large a question to be dealt with here, so all that need be said is that the traveller should provide himself with wire mesh fly covers to screen food and also with pieces of mesh or calico weighted with beads, which can be utilized for covering vessels containing milk or other liquids. It is worth noting that ordinary fish netting hung over a tent door or used to screen the windows or doors of a house will effectively exclude flies, despite its large mesh.

Tsetse Flies.—These are considered under Sleeping Sickness (*see* page 234).

The Congo Floor-maggot Fly.—It is the maggot or larva of this fly which is important, as in many parts of Africa it infests the floors of native huts and it is a blood-sucker feeding at night. So far as is known it does not convey any disease but it is an unpleasant visitor, and if its numbers are great they may extract comparatively large quantities of blood from their unconscious victims.

Prophylaxis.—General cleanliness and enforcement of sanitary measures, the use of high beds, the scrutiny of sleeping mats and blankets in which eggs or larvae may be concealed. Infected huts can

be rendered habitable by firing the ground or by removing the surface soil, which can then be disinfected.

Wingless Pests.—Lice.—These are known to transmit typhus fever. Further, they often cause great cutaneous irritation and are loathsome companions. It is no easy matter to get rid of lice when infection is on a large scale, but very often this is not the case and it is possible to detect their presence only by careful examination. There is no real difference between head lice and body lice; they are simply varieties of the same insect. The presence of head lice may be recognized by the discovery of their eggs, which are known as nits and are minute, yellowish-white, goblet-shaped bodies about the size of a full-stop on this page. Examination for head lice is much facilitated by the use of a fine tooth comb. Persons suspected of harbouring body lice should be examined first for the actual bites of the insect on the skin. Their clothes, and especially their under-garments, should then be carefully examined, attention being more particularly directed to the seams and folds where the eggs, if present, are most likely to be found.

The best preventive measure against lice is strict personal cleanliness. Clothes should be frequently changed, and as frequently washed. The hair should be kept cropped short, especially at the sides and back of the head, and in the tropics it is very advisable to shave all hairy parts of the body.

Space does not permit a full account of how to deal with verminous persons and verminous clothing, but it may be said that the only reliable methods of destroying lice are by hot air, steam, boiling water, or hydrocyanic acid gas. At the same time it should be noted that the heads of those infested with head lice should be thoroughly combed and treated with paraffin, petrol, or white precipitate ointment, and then well washed with carbolic soap. The nits may be loosened by treatment with warm vinegar or acetic acid. In the case of body lice possibly the most satisfactory grease for application to the underclothing is one composed of crude unwhizzed naphthalene from the coke oven, four parts, and soft soap, one part. It is important that the proper type of naphthalene be used.

A useful palliative method is the ironing of clothing, especially along the seams, with heavy hot irons.

Fleas.—Bubonic plague is known to be transmitted by fleas, and it is possible that they play a part in the transmission of that form of

leishmaniasis which is known as kala-azar (*see* p. 202). Fleas dislike powdered naphthalene and pyrethrum powder, and either of these may be applied to the clothes to ward them off.

A note on the troublesome *Chigger flea* or *Jigger* will be found under "Skin Diseases" (*see* p. 228).

Bed-Bugs.—The traveller sleeping in hotels or inns abroad is very apt to be attacked by bed-bugs, which harbour in wooden beds and bedding, crevices in walls, floors and ceilings, and other places which are dark and sheltered. Fortunately, so far as is known, the bed-bug does not carry any disease, but its bites are annoying, and its presence is a sign of insanitary conditions. It is difficult to protect oneself against bed-bugs without instituting a campaign against their hiding-places and breeding-places, but a skin ointment like vermijelli is useful, and powdered naphthalene or Keating's powder may deter the insects to some extent.

Note.—Keating's powder, which contains pyrethrum, is slow in its effects, and therefore, if possible, should be shaken over the sleeping bag or blankets some hours before bedtime. If not, the pests will struggle through it and find renewed vigour on the sleeper. It is best in very bad quarters to rub the powder on the skin as well as to dust it over the bed. It will not kill a full-grown bug under an hour, but it is extraordinarily effective with fleas. It is important to obtain a good pyrethrum powder, as such preparations are frequently adulterated.

The *Itch Insect* is the cause of the skin disease known as scabies. It is a mite, the female of which burrows under the skin to lay her eggs. The favourite site for her operations is between the fingers, but other parts of the body may be affected, and the rash produced may assume various forms, so that it is well in the case of any skin eruption in the tropics to remember the possibility of scabies.

Treatment.—Its effective treatment is by no means easy, and would take much too long to detail here. All that can be said is that the skin should be washed well with soap and hot water, and that thereafter a liberal quantity of sulphur ointment should be thoroughly rubbed into the skin twice daily for three days. On the fourth day recourse should be had again to soap and hot water, if possible in the form of a hot bath. Meanwhile, clothing and bedding should be boiled or destroyed.

Ticks.—The most important tick from the traveller's point of view, at least, in Africa, is the species responsible for the transmission of tick

fever (*see* p. 242). It would seem that the fowl tick may occasionally attack man, and some believe that it may spread the infection of certain kinds of relapsing fever (*see* p. 218). The larval stages of certain ticks are often very troublesome in many parts of the world, owing to their habit of burrowing into the skin of persons coming into contact with them.

Treatment.—When a larval tick is found half buried in the skin, force should not be used in an attempt to remove it, because either the surrounding skin is unnecessarily damaged or, as is most probable, the head of the tick is ruptured, its rostrum or beak remaining buried in the skin. The result is severe irritation which may lead to septic infection. The best way, therefore, of dealing with a tick larva lodged in the skin is to dip a small camel's hair brush in turpentine, benzene, petrol or paraffin, and apply it between the skin and the under surface of the tick. In a short time the tick will let go its hold and may be swept from the skin with the brush. Vaseline is also effective if smeared over the tick. To remove a rostrum which remains in the skin after a tick has been forcibly ejected, cocaine should be applied to the spot, and the rostrum extracted with needle forceps, iodine being thereafter applied. A special form of tick-case devised for dealing with this condition is upon the market, and is a useful addition to the traveller's outfit.

Ants.—These are often very troublesome owing to their depredations on foodstuffs, and it must be remembered that experimentally ants have been shown capable of carrying the organisms of typhoid fever and cholera, though under ordinary conditions they are not likely to be very dangerous in this respect. Some form of pyrethrum powder, such as Keating's, will be found useful in checking the depredations of ants, or they can be prevented from getting at food on tables by tying paraffin-soaked rags round the legs of the latter. Powdered borax or paraffin are useful in dealing with so-called "ant-routes" into tents or houses.

Iritis, or Inflammation of the Eyeball Itself.

Symptoms.—In this there is pain, the vision is dimmed, and the transparent part of the eye is found to be cloudy. Skilled assistance is necessary.

Treatment.—Apply hot fomentations and boric acid lotion; leeches or a blister to the temples are of service, and the pupil, which is contracted, should be dilated by dropping two or three drops of a one per cent. solution of atropine on to the eye twice a day or oftener till it is well dilated; only enough drops should be applied afterwards to prevent the pupil from contracting. Dark glasses may be worn with advantage. The bowels should be kept well open, and one grain of calomel may be given three times a day for a week, or longer if it does not cause a coppery taste in the mouth, with tenderness of the gums and excessive flow of the saliva. As the inflammation subsides a shade may be adopted.

Night blindness and snow blindness are due to exposure to the glare



FIG. 2.

either of the sun or of the snow. To avoid these complaints tinted glasses should be worn. Travellers in snowy regions should be provided with smoked glasses; if these get broken or lost, some opaque substance may be smeared over the surface of an ordinary pair, leaving a narrow horizontal slit of clear glass—in the Esquimaux fashion, as shown in the accompanying illustration. On snow it must be remembered that the perforated wire gauze sides are essential for protection from the reflected rays of the sun. Elastic may be substituted with advantage for the ordinary metallic attachments, between the glasses as well as around the head.

Jaundice.

Jaundice, which is a condition in which the skin and mucous membranes assume a yellow colour, may be due to various causes. One of the commonest forms is that known as catarrhal jaundice, which is

induced by chill, exposure, dietetic disturbances, etc. It should be treated by calomel and salines. Violent purges are to be avoided. Bismuth and bicarbonate of soda should be given, and the diet should be regulated and should consist of simple and bland articles of food, free, as far as possible, from fats.

There is a form of jaundice associated with infective conditions, such as the enteric fevers, dysentery, malaria, relapsing fever and yellow fever. In these cases the jaundice is to be treated like the catarrhal form, and the accompanying condition requires attention.

In addition to the above there is a camp or infectious jaundice, the nature of which is somewhat obscure, but which is associated with a considerable degree of illness.

Symptoms.—The condition commonly begins with shivering, a rise of temperature, headache, giddiness, general malaise, sleeplessness, loss of appetite, nausea, and it may be vomiting. The tongue is coated, and there may be pains in the back and legs. The jaundice usually lasts from seven to nine days, and about the fifth day the temperature falls, though there may be a secondary fever.

Prophylaxis.—So far as we know at present this is a question of enforcing good sanitary surroundings, and paying special attention to the hygiene of food and drinks, which should be guarded from the access of flies.

Treatment.—This is entirely symptomatic and should be that of any ordinary febrile attack, together with the measures employed in catarrhal jaundice. There is a severe form of jaundice of an infective nature which is associated with the presence of a parasite in the blood, very like that of yellow fever, and which apparently is derived from infected rats. This form of jaundice is, however, not very common and need not be further considered, especially as it requires skilled medical attendance.

Laryngitis, or Inflammation of the Upper Part of the Windpipe.

The organ of the voice is called the "larynx."

When the windpipe is affected it is somewhat tender on pressure, there is hoarseness, cough, and pain in swallowing. Treatment similar to that for cold in the head may be adopted; in addition, the upper part of the front of the throat should be kept well poulticed for a day

or two, and then wrapped up in cotton wool for some days longer. A piece of mustard leaf covered with six layers of a handkerchief and secured by a bandage, can usually be borne for a considerable time, and is often more efficacious than the poultice; when the smarting is great the mustard leaf should be removed and the tender part smeared with oil or vaseline.

Inhalations of steam are of use in promoting expectoration. Carbonate of ammonia, three grains, or bicarbonate of potash, five grains, with half to two grains of ipecacuanha, will help to promote secretion from the affected part. A teaspoonful of Friar's balsam in a pint of hot water makes a good inhalation.

Leeches.

Persons travelling in India, Ceylon, the Far East generally, and the Philippine Islands, are likely to make the acquaintance of the Asiatic leech, which is a very troublesome and indeed dangerous species of vermin. It is very small, only about an inch long, and of the thickness of a knitting-needle. It is able to penetrate through the interstices in clothing, and when in vast numbers it is a foe difficult to combat. The bites of these leeches are painless and much blood may be lost before their presence is discovered. It is very difficult to obtain any kind of boot or puttee which will keep these creatures at bay, and the traveller in these countries should be provided with a solution of salt or weak acid which, on application, causes the leeches to loose their hold. It is a mistake to try and drag them off the skin, as parts of their biting apparatus are apt to be left behind and set up inflammation and suppuration. Tincture of iodine should be applied to the site of a leech bite. In forest regions where these leeches abound protective measures must be taken at night, the best being the use of a properly adjusted mosquito net of very fine mesh.

The tropical water leech is found in the Azores, the Canary Islands, Africa, Palestine, Syria, Armenia and Turkestan. It may reach a length of four inches, and if swallowed with drinking water usually fastens on the mucous membrane of the mouth or throat. As a preventive measure drinking water should be passed through a piece of muslin or similar form of sieve.

Leishmaniasis.

This condition is named after Sir William Leishman, who discovered the parasite producing it. There is a general and febrile form of the disease and also a form attacking the skin and mucous membrane of the mouth and nose, which is considered under Skin Diseases.

The systemic form of the disease is commonly known as kala-azar, which signifies "black sickness." It is common in certain parts of India, notably Assam, but is found also throughout the Far East, and it occurs in Arabia, in the Anglo-Egyptian Sudan and in the Mediterranean area. A case has also been described in South America, in parts of which it is possibly more common than is generally supposed.

Cause.—The parasite, which lives in the blood and tissues, is known, but its exact method of transmission to man is still in the realm of uncertainty.

Symptoms.—The disease begins in an indefinite manner and then assumes the form of a continued fever, associated with enlargement of the spleen and liver and progressive emaciation. Bleeding from the nose is not uncommon, and in Europeans the peculiar earthy-grey colour of the skin is very striking. The disease lasts for months and even years and is very frequently fatal.

Prophylaxis.—As we do not know how the disease is spread it is not easy to recommend preventive measures, and all that can be said is that every care should be taken to isolate the sick, to live under healthy conditions and to avoid contact with vermin of all kinds. As dogs may possibly be carriers of the disease they should be destroyed if proved infected.

Treatment.—Antimony is the best and indeed the sole remedy, but it can be given only by a medical man, so that nothing further need be said here regarding it.

Liver, Congestion of:—

The *Liver*, which is mainly on the right side, lies below the right lung, and is protected by the lower ribs. In health it extends vertically from one-and-a-half inches below the right nipple to the lower edge of the ribs; in certain diseases it is enlarged, and its edge can be felt well below the ribs.

Congestion of the liver is frequent in the tropics, and is often due to malaria or dysentery. Very frequently it is caused by abuse of alcohol, over-indulgence in food, and the excessive use of hot condiments, or by constipation and want of exercise. In the tropics the liver is more easily affected by excesses than in temperate climates.

Symptoms.—A furred tongue, sallowness of the face, headache, lassitude, disinclination for work, loss of appetite, tendency to vomit, occasional slight jaundice, and a sense of oppression about the region of the liver.

Treatment.—Light diet, abstinence from alcohol and spices, and the use of calomel or other aperient will usually effect a cure. Ammonium chloride, five to ten grains, three times a day, should be given.

Liver, Acute Inflammation of:—

In this complaint there is severe pain, some fever, and frequently jaundice. The complaint is serious, as abscess of the liver frequently follows it, at least if it is due to amebic dysentery.

Treatment.—The patient should be put to bed, hot fomentations applied to the seat of pain, and the bowels well relieved. Emetine should be at once administered as for dysentery, or ten grains of ipecacuanha should be given three times a day. Ammonium chloride in full doses (twenty grains three times a day) often does good, and can be retained when ipecacuanha cannot, but it is unpleasant to take, so the dose should be given in one or two ounces of water. The wisest course for one who has had a severe inflammation of the liver is to get away to a healthy climate.

Liver Abscess.

It is extremely difficult for the traveller to decide if abscess of the liver is present; it may be suspected if a patient, convalescent from dysentery, still remains feeble and ill, or if he has an irregular temperature, a muddy complexion, night sweats, wasting, and pain or uneasiness in the right shoulder. Sometimes a definite swelling can be made out. A dry cough is not uncommon.

Treatment.—Emetine is the specific treatment for the prevention of liver abscess, and it would seem in some cases actually able to bring

about a cure even when the abscess has formed. It should be given as for amebic dysentery (p. 187), and it is essential that a patient with liver abscess should as soon as possible come under medical control, as it may be necessary to give emetine by the needle subcutaneously or even to inject it into the abscess cavity. Ammonium chloride may be given; the patient's strength must be supported, and he should be as quickly as possible placed under the care of a surgeon, who will probably decide to operate. If this cannot be done, then the patient should not be interfered with surgically, for he will have a better chance of recovery if the abscess is allowed to burst naturally than he would if the traveller attempted to operate.

Malaria.

Of all diseases in the tropics malaria is the one which is most likely to trouble the traveller. Hence it is essential that he should be well posted regarding it. In addition to the books which have already been indicated he will find the recently published 'Malaria at Home and Abroad,' by Colonel S. P. James, a work of much value and interest. It is true it is more especially intended for the medical man, but any intelligent layman can study it with interest and profit, and the chapters dealing with prophylaxis and treatment are specially valuable and well up to date. Here it is possible to give only a mere outline of the chief facts concerning the disease.

1. Malarial fever is caused by a small animal parasite which lives chiefly in the blood of patients attacked by it. 2. Under ordinary conditions in nature it can be conveyed only from one person to another by the bite of a mosquito which has previously sucked the blood of an infected person. 3. The parasite undergoes a series of changes in the mosquito's body and eventually finds its way to the salivary glands of the insect whence it is injected through the mosquito's proboscis into another victim. 4. There are only certain species of mosquitoes, belonging to the family Anophelineæ (from a Greek word signifying "harmful"), which can carry malaria, and it is only the females of these species which are affected as the males are not blood-suckers. Anopheline mosquitoes breed in shallow puddles and in almost all collections of stagnant or gently flowing water. It is therefore very dangerous to pitch camps close to stagnant pools, sluggish reed-grown

streams or marshy places. 5. In the tropics one of the chief reservoirs of infection is the native, and more especially the native child, who frequently harbours the malarial parasite in the form which is adapted for life and reproduction in the mosquito and hence is a distinct source of danger. It is therefore inadvisable to camp in the vicinity of native villages or to spend a night in the neighbourhood of native habitations unless efficiently protected from the bites of mosquitoes.

Symptoms.—Malarial fever presents itself under two chief forms, though it should be noted that malaria is one of the most protean of all diseases and may simulate any malady. (1) *Intermittent fever.* In this disease the temperature may rise high, but returns each day to normal or lower; hence there is, after each attack, a period of complete freedom from fever. An intermittent fever or *aguio* is usually less serious than a remittent fever, but it is harder to cure in the long run. (2) *Remittent fever.* In this the temperature, though it varies, keeps constantly above the normal, and the higher the fever, and the slighter the difference between the extremes of temperature, the more serious is the condition of the patient. Where the temperature is remittent, and appears to be unaffected by quinine, the disease is probably not malarial, but may be a case of enteric fever, and should be treated as advised below under that heading.

The attack may be sudden, but it is usually preceded by a feeling of languor, yawning, and general discomfort; this is followed by the *cold stage*, which, in the tropics, is usually short, and in the more ordinary attacks is ushered in by a violent shivering fit or rigor, though this is not common in Central Africa. The sensation of cold is entirely subjective, for though the patient feels chilly and piles clothes upon himself, his temperature will be found elevated. At this period violent vomiting is not infrequent. Then comes the *hot stage*, often of long duration, followed by the *sweating stage*, during which the perspiration pours from the patient and soaks everything on and about him. After this there is a period of remission, or intermission of the feverish symptoms with corresponding relief to the patient. Usually, after some hours, the attack comes on again, beginning with the cold stage, but if the fever is treated very early, the disease may now pass off. The whole attack lasts as a rule from six to ten hours, say one hour for the cold stage, three or four for the hot period, and two to four for that of

defervescence. There is sometimes a feeling of pain and discomfort in the right side owing to the congestion of the spleen, which enlarges during the rigor.

There are three distinct species of malarial parasite, and each causes a different type of fever. According to the type with which the patient has become infected, the fever recurs after one, two, or three days. At the same time all kinds of febrile irregularities are met with, so that it is often impossible to diagnose the disease in the absence of blood examination for the detection of the parasite.

Anæmia is a constant feature of the malarial attack, as is but natural, considering the great destruction of red blood cells brought about by the parasites which have infected them.

Prophylaxis.—Only those preventive measures which can be put into operation by the individual will be here considered. This may be called *personal prophylaxis*. By far the most important means of avoiding malaria is the proper use of an efficient mosquito net. The oblong type is best, and it should contain sixteen meshes to the linear inch. Round the foot of it should be sewn a stout layer of calico 2 feet in depth. This will permit of a foot of the material being tucked under the mattress while the upper foot remains in the form of a belt or zone round the bed. It is necessary, because in its absence the sleeper is very liable to be bitten through the mosquito-net mesh, with which his arms or legs are apt to come in contact. Care must be taken to see that the net is kept in good repair—a most important matter—and in very malarious countries it is advisable to provide every member of an expedition, native or otherwise, with a good mosquito net. In what may be called the dry tropics, the top of the net may be of mesh; in the moist tropics, it is best made of calico in order to keep off the heavy dews. The traveller often sleeps out on the deck of river steamers, and then it is certainly advantageous to have the roof of the net composed of stout calico, as sparks from the funnel are very apt to alight upon it, and naturally holes will be burnt much more readily in mesh than in thick cotton. It is foolish to sleep even for one night in a malarious locality unprotected by a net.

The net is for use during the period of sleep, but one is very apt to be bitten by infected mosquitoes just after sunset, and hence it is well to make use of some form of mosquito canopy. A good type is the so-called

mosquito umbrella tent. Such a canopy may be arranged so that the evening meal can be taken in it. One servant will be inside the canopy and receive the dishes through a guarded opening from the attendant outside.

Other methods of protection exist in the shape of mosquito boots or buskins. The best type of mosquito boot is the form which reaches right up the thigh. They may be made of untanned leather or of stout khaki cloth. All mosquito boots and buskins should be provided with soles to protect the feet from wet and damp. In the absence of boots it is well to know that a mosquito will not bite through two pairs of stockings, one super-imposed over the other. This is a way in which women can protect their legs and ankles, or they can employ the buskin, leggings, gaiters, or puttees.

Mosquito veils have been mentioned, the best type being the "Mosquinette" hood.

Mosquitoes are apt to bite through chairs with cane seats or with perforated seats, and these should be guarded by a layer of brown paper, newspaper, or a cushion.

Repellent substances may be used, smeared on the skin. They contain essential oils, such as oil of cassia or eucalyptus oil. These repellents are effective only for a short time, but lessen in some degree the liability to infection.

The prophylactic use of quinine has recently fallen somewhat into disrepute, owing to its comparative failure in many of the war areas, but there can be no doubt that under conditions of civil life it is a valuable auxiliary method, if properly employed. One of the troubles about it is that quinine is rapidly excreted from the body, and hence after a dose it remains in the blood only a comparatively short time; for example, if the dose be taken at 6 p.m. it is very doubtful if enough quinine will be left in the blood at 2 o'clock in the morning to kill any malarial spores which may be introduced into it by an infected mosquito. The ideal method of taking quinine prophylactically would be to take a dose of 5 or 6 grains with the evening meal shortly before sunset. This will protect until it is time to get under the mosquito net. If for any reason it is impossible to employ the latter, then a second dose of quinine should be taken at midnight. This is difficult to accomplish, and hence something may be gained by taking a larger dose of quinine at night on

the chance that some of it may remain in the blood for a longer period than would the smaller quantity. As much as 10 grains may therefore be taken under these conditions. Some persons, however, cannot stand 10 grains of quinine daily for a long period of time.

It is clear from what has been said that prophylactic quinine should never be taken in the morning, and also that it is merely an auxiliary method, and does not do away with the necessity of using the mosquito net. Sugar-coated tablets should be avoided, and care must be taken to see that the products or tablets which may be used are readily soluble. It is a good plan to crack the products before swallowing them. A good salt of quinine is the bisulphate, which is soluble and comparatively cheap. When the drug is given in powder, tablet, or pill form, it should be followed by a wine-glassful of water, and it is advisable to acidify the latter by a few drops of hydrochloric acid. There is no doubt that as a general rule quinine is best taken in solution, but in the case of persons travelling about this is not always easy to arrange, and if the above precautions be taken the solid form will generally be found effective. It is better to take prophylactic quinine in daily doses, because if an interval is allowed to elapse between doses one is apt to forget to take the drug at the proper time. Hence it is well to make it a kind of ritual to take the quinine along with the evening meal, for it is certainly an advantage to do so on a full stomach. It should be remembered that persons who take their quinine regularly do not suffer from blackwater fever, while the irregular taking of quinine certainly appears to favour the occurrence of the latter. It is better not to take prophylactic quinine at all than to take it in a haphazard and irregular manner.

Treatment.—The three great principles of treatment are: (1) To open the bowels; (2) to produce perspiration; (3) to give quinine. The routine to be adopted is as follows. Put the patient to bed in flannel pyjamas, and covered up well with blankets; in all cases, save where there is diarrhoea, give an aperient, such as four grains of calomel, or two tabloids of Cathartic Co, or two Livingstone's Rousers, and if this does not act, repeat the dose in about four hours. If free evacuation is not produced, a warm-water enema should be given. A hot-water bottle in bed is useful. Sponging with warm water often gives relief at the beginning of a fever, and tends to shorten the cold stage. At the same time hot drinks should be given, such as weak tea, in order to promote

perspiration and cut short the hot stage, and at this stage, *i.e.*, at the outset of the fever, 10 grains of Antipyrin, or 10 grains of Phenacetin, may be found useful for inducing perspiration, or four tablets of Warburg's Tincture, which contains some quinine, may be substituted for them. Antipyrin and Phenacetin should not be given except in the earliest stages of the fever.

During the hot stage cold applications, such as cloths wrung out of cold or iced water and sprinkled with eau de cologne, vinegar or spirit may be applied to the forehead and behind the ears. The bedclothes should be lightened and drink freely supplied, unless it seems to promote vomiting. If the temperature shows signs of getting above 105° F. sponge the patient with warm water or cradle the bedclothes, as it is called—that is, remove them from contact with the body by some simple means. In the sweating stage strip off the soaked pyjamas and sheets and get the patient into warm, well-aired night-clothes and bed-clothes. If there is any tendency to collapse a little stimulant may be given—say, a dessert-spoonful of brandy. In most cases alcohol is better avoided. If vomiting is bad withhold all food, and give bits of ice to suck if it can be obtained.

Whilst the above methods of treatment are important, it should be clearly recognised that the one drug which can alone counteract the malarial affection is quinine, and it is upon the proper administration of quinine that successful treatment largely depends.

This proper administration necessitates at the outset rest in bed, and it also necessitates a continuance of the drug for a sufficient length of time. For ordinary cases the best way is to give quinine by the mouth, and here again it is best given in solution, though it can be administered in solid form if the precautions above indicated are duly observed. Various doses have been advocated, but probably the best quantity to administer is 80 grains every twenty-four hours. This is usually given in three doses of 10 grains each, but there would appear to be an advantage in giving four doses instead of three, and Colonel James advocates the following times for administration, *i.e.* 12 midnight, 6 a.m., 12 noon, 6 p.m. He does so, because such a method of administration is likely to ensure that there shall be a sufficient concentration of quinine in the blood at the time when the youngest forms of the parasite are present. The patient should remain in bed, if

possible, for ten days, or, if this is impossible, for at least half that period; and it is essential that the quinine should be given as soon as possible, and quite irrespective of the stage of the attack or the height of the fever. If its administration is followed by vomiting, give a small teaspoonful of bicarbonate of soda in warm water. If this is rejected repeat the dose, and then give some form of stomach sedative, such as bismuth, and dilute hydrocyanic acid or 20 drops of chlorodyne. A mustard leaf applied to the pit of the stomach is often helpful. Sometimes drop doses of tincture of iodine, well diluted, will check these troublesome symptoms. Under ordinary conditions this 80-grain quinine treatment should be steadily continued for at least five days, but in troublesome cases it may be necessary to carry on with it for as long as three weeks. Thereafter what is called the "after treatment" is begun and must be continued for a period of three months, in order to ensure, if possible, an eradication of the infection.

There are several ways of carrying out this after treatment, but one of the simplest and most effective is to administer 10 grains of quinine every day, the dose being taken an hour or two before the time at which the fever was apt to come on during the attack.

If, despite quinine treatment, relapses occur, the patient must go to bed and be treated as for the first attack, and the after treatment must again be carefully carried out.

Under certain conditions quinine has to be injected by the needle, either into the muscles or into a vein; but, as a rule, this should not be done save by the medical attendant. It should, however, be remembered that the drug may be given by the bowel, in which case twice the quantity of quinine which would be administered by the mouth should be given. It is only exceptionally that this procedure will have to be followed, but it is sometimes useful in the case of children.

The feeding of the malaria patient is important. Between the attacks of fever, or during the sweating stage, he should be given food in fluid form, such as chicken broth, eggs beaten up with milk, raisin tea, etc.; and as soon as his stomach will stand it, the diet should be increased. Tonics, such as iron and arsenic, are required during convalescence.

In cases where there is acute malarial poisoning, with temperature 106° F., or even higher, do not wait to undress the patient or get a bath, but empty gallons of water over him, one boy keeping the head

constantly soured; while this is being done a bath can be procured and the patient then undressed, or, better still, have his clothes cut off, because it is dangerous to lift such a patient about too much. Remember that when a patient is very ill and weak, he should not be allowed to stand or sit up suddenly, as he may faint.

Delirium with high temperature, say 106° F. or over, is a certain sign that the fever is doing harm, and must be reduced.

The temperature and pulse should be carefully watched when the cold water treatment is employed.

Malta Fever. (See *Undulant Fever*.)

Measles.

Incubation period, ten days. Rash occurs on the fourth day.

Rash.—Pink spots, round or irregular, slightly raised above the surface, tending to run together in patches over the body, leaving the unaffected skin between them clear. In the early stages often best marked on the face and behind the ears.

Symptoms.—Fever, catarrh, congested eyes, running from the nose, sickness and cough.

Treatment.—Similar to that of scarlet fever (see p. 222). It is very important to guard against chill; to ensure plenty of fresh air.

Complications.—Measles may be followed by pneumonia.

Mumps.

This is an infectious disease, characterised by swelling of the salivary glands. Its chief importance to the traveller is that if once it makes its appearance it may spread rapidly through his native attendants, and that it is apt to be followed by inflammation of the testicle.

Symptoms.—The invasion is accompanied by fever, which is usually slight, but is sometimes severe. There is pain just below the ear on one side, followed by a swelling which gradually increases, causing great enlargement of the neck and side of the cheek. In a day or two the other side of the face is usually affected, and sometimes the condition spreads under the lower jaw. It persists from seven to ten days, then gradually subsides. Inflammation of the testicle may be troublesome. It is usually one-sided.

Treatment.—Rest in bed during the height of the disease. Get the

bowels freely open and keep the patient on a light diet. No medicine is required unless the fever is high. Either cold or hot applications may be made to the swelling. If the testicle is involved it should be treated by rest and protection with cotton wool.

Myiasis.

This is the name applied to the condition in which the larvæ of flies are found parasitic in the body. It may be cutaneous, nasal or intestinal. The last named is not of great importance. Different species of flies may be concerned; thus in Africa, one of the best known flies producing this condition is called on the West Coast the *Tumbu fly*. The fly itself is about the size of a small blue-bottle, and is yellowish-grey in colour. It has a fat white larva, which burrows under the skin and produces a small boil or wheal, in the centre of which there is an opening which, unless blocked up by discharge, looks black owing to the presence of excrement from the posterior end of the larva. The skin round the hole becomes inflamed and very itchy. The commonest site is the forearm, but in Europeans various parts of the body may be attacked.

Treatment.—When small the larvæ can easily be squeezed out. They are, however, best extracted with forceps, and this is more readily done if a little chloroform is injected into the maggot before it is removed. Apply local sedatives, such as lead and opium and, after removal of the maggot, paint the skin with iodine. Indeed, if there is some delay in getting the maggot removed, it is well to apply tincture of iodine to the skin to prevent the occurrence of suppuration.

In Central and South America we meet with the so-called *Ver macaque*, which is the larva of another species of fly, and which gets under the skin in much the same way as does that of the *Tumbu fly*. It causes a great deal of pain, especially when it is moving about. It should be treated on the same lines as above.

The *Screw-worm* is also met with in America, and is the maggot of a fly which lays its eggs on the surface of wounds and in the ears and nose of persons sleeping in the open air. The maggots burrow into the tissues and may bring about a very serious condition if not detected at an early date and removed.

Treatment.—Injections of chloroform are one of the best ways of getting rid of maggots in the ear or nose, but medical attention is required. Wounds should be protected and kept clean. If infected they may be treated with turpentine, a painful but effective method.

Ophthalmia, Simple.

Simple ophthalmia, conjunctivitis, or inflammation of the membrane covering the eye and the inner side of the eyelids, is usually due to cold or dust.

Symptoms.—The affected eye is bloodshot and painful, waters freely, and cannot bear a bright light; there is a feeling of grittiness, as if the trouble were due to something between the eye and eyelid.

Treatment.—The eye should be carefully washed, the eyelids being opened and clean, cold water allowed to run over them and over the eye; any particles of dust must be removed—for this purpose a small clean camel-hair brush will be found useful. A lotion should be made consisting of six grains of boric acid, or two grains of sulphate of zinc, to an ounce of water, and ten drops or more of this should be dropped on to the eyeball six or eight times a day. To prevent the lids sticking together during the night, they should be smeared with vaseline or a salve containing 4 grains of calomel to an ounce of vaseline. Sometimes hot fomentations give relief.

Ophthalmia, Purulent.

This is a more serious inflammation, and is caused by some poison, e.g., germs carried by flies, or by the fingers from unhealthy sores and discharges. It may also result from injury, such as a septic wound.

Symptoms.—The symptoms of simple ophthalmia are present, but are all intensified, the eyelids are swollen and the eyeballs red, there is a discharge of yellow matter or pus, and the patient feels ill. There is great danger of the affected eye infecting the sound one, therefore warn the patient not to touch the sound eye for fear of infecting it. There is also great danger lest the attendant's own eyes should become infected.

Treatment.—The patient should be kept in bed and the eyes should be shielded from bright light. Protect the sound eye (especially when the affected one is being washed) by placing a pad of wool or lint over it,

kept in its place by strips of strapping so as effectually to close the eye and prevent infection. Thoroughly wash out the space between the eyelids and the eye, and remove any matter or foreign body which may be found.

When the inflamed surfaces are clean, wash them very thoroughly with a solution of corrosive sublimate, 1 in 5000, and finally smear a little vaseline along the edges of the lids, to prevent them sticking together. This treatment must be repeated as frequently as possible. Once a day the inflamed surfaces may be brushed over with a solution of nitrate of silver, 10 grains to the ounce, applied with a camel's-hair brush, followed immediately by the application of a few drops of common salt solution.

Hot fomentations may give relief. When this is so, the eye should be kept covered with a pad of moist lint, which must be changed frequently. Benefit has followed the administration of very large doses of salicylate of soda.

Piles.

Piles are very common in the tropics, and are often due to want of exercise, chronic constipation, dysentery, too free use of alcohol, and over-eating. No one who suffers from piles should become a traveller till skilled advice has been obtained.

Internal Piles, though not usually painful, are by their frequent bleeding a cause of anæmia and debility; they lie inside the orifice of the bowel, but sometimes they come down on straining, and are then nipped by the muscle surrounding the opening, and may swell up, become very painful, and bleed profusely.

Treatment.—Keep the bowels freely but gently opened by taking cascara regularly; if the piles come down they should be returned, and an ointment of galls and opium or an injection of hazeline (one tablespoonful mixed with seven of water) used. Tannin, five grains to the ounce, or sulphate of iron, three to five grains to the ounce, may be used instead of hazeline. Hazeline suppositories are often of great use for internal piles, but ordinary suppositories do not keep well in very hot countries; if they are taken to the tropics they should therefore be specially made and packed. If the piles bleed profusely or cause great pain, an operation will be necessary.

External piles do not bleed, but from time to time they become inflamed and swollen, causing great agony.

Treatment.—The bowels should be kept well opened; the sufferer should lie with his hips raised; hot fomentations should be frequently applied, and the piles should be well greased. Glycerine of belladonna, smeared on a pad of lint, is a valuable application, as is dry calomel powder.

Some sedative, such as Dover's powder, may be necessary to procure rest and sleep.

Plague.

There are two chief varieties of plague, the bubonic and the pneumonic.

Causes.—Bubonic plague, which is due to a small vegetable organism, the *Bacillus pestis*, exists primarily as a disease in rats and other rodents, such as the Manchurian marmot and the Californian brown squirrel, and is transmitted from these animals to man by means of the flea. It is the rat flea that is, chiefly concerned in the spread of plague. Both the brown and the black rat are affected and, speaking generally, the black rat is the more dangerous, as it lives in closer association with man. It is now known that certain forms of merchandise, especially grain and, to a lesser extent, raw cotton, are more to be dreaded as vehicles of the bubonic plague infection than the infected human being.

The flea does not inoculate the bacillus by its bite. It sucks up blood containing plague bacilli. The latter multiply in the insect to such an extent that they block the entrance of the flea's stomach and prevent it from feeding. The starved flea makes violent efforts to obtain more blood and, as a result, the contents of its gullet are discharged, together with the plague bacilli, upon the skin of the healthy person on whom it is trying to feed. If there is any little wound in this skin the bacilli gain an entrance and they set up the disease. Infection may also occur from the bacilli-containing excreta of the flea being voided on the skin and rubbed into wounds. When rats become ill or die the fleas leave them and attack man. It should be noted that the rat flea may remain infective for 48 days.

Pneumonic plague, although due to the same bacillus, is quite a different kind of disease, and is transmitted from the sick to the sound by droplets of sputum expelled in coughing, and probably also by the invisible spray which pneumonia patients discharge from the mouth.

When the disease is epidemic domestic animals may suffer from it and become sources of infection.

Symptoms.—Both forms of plague are characterised by sudden onset, sharp fever, giddiness, great weakness, a drunken gait, appearance and speech, and a tendency to heart failure.

In bubonic plague there is lassitude, headache and shivering, and the face is pale and anxious. The patient looks haggard, his eyes are often bloodshot, and his expression is frequently one of fear or horror. His temperature runs up to 102° , 104° F., or even higher, and his face gets hot and flushed. There is intense thirst, the tongue becomes dry and brown, the urine is scanty, and there may be delirium. About the second or third day the glandular swellings known as buboes make their appearance, usually in the groin, but they may occur in the armpits, the neck, and elsewhere. As a rule there is only one bubo, which varies in size. There may be a good deal of pain associated with the swelling, and sometimes it is very severe. The bubo, if not dealt with surgically, eventually softens and bursts, discharging matter and sloughs. In cases which are going to recover, improvement is noted about the fourth or fifth day, and is heralded by a profuse perspiration. In fatal cases, death usually takes place between the third and fifth days.

Pneumonic plague usually begins with shivering and vomiting. There is a cough, accompanied by breathlessness and blueness of the face, the sputum is profuse, watery and blood-stained, and as it is full of plague bacilli it is exceedingly dangerous. Very few cases of pneumonic plague recover.

Prophylaxis.—Ward off attacks of fleas. A substance called pesterine is good for this purpose, and consists of kerosene 20 parts, soft soap 1 part, and water 5 parts. Powdered naphthalene and tricresol powder are useful. Attendants on plague patients should be protected from infection. They should wear puttees or gum-boots, gloves, and overalls, and those looking after pneumonic cases must wear masks, goggles, and overalls. There is a protective vaccine for plague, and those travelling in districts where plague is epidemic should avail themselves of its protective power.

Treatment.—The only treatment which is of any value, and this only in bubonic plague and when given early, is the administration of plague anti-toxin, which should only be given by a medical man. The symptoms should be treated in order to relieve the patient's distress. Belladonna

and glycerine may be applied to the buboes, and they should be opened and carefully dressed once suppuration is established. Morphia is often required for the restlessness and insomnia, and cardiac stimulants are indicated in nearly every case.

Pleurisy, or Inflammation of the Membrane Covering the Lung.

This is more a disease of cold climates, and is usually the result of chill following severe exertion.

Symptoms.—Pleurisy is accompanied by less fever and general sickness than pneumonia; its characteristic symptom is the "stitch in the side," which always accompanies it. There is also a short, dry cough, without expectoration, which the patient tries to restrain, as it "catches" in the side, and causes acute pain. For the same reason the breathing is shallow, as any attempt to draw a deep breath causes extreme suffering.

Treatment.—The patient suffers greatly, therefore in the early stages treatment must be directed to the pain. If leeches are procurable, the application of half-a-dozen to the painful region of the chest is advisable. Mustard leaves or poultices should be applied over the part, or it may be painted with tincture of iodine; opium may be given to relieve the acute pain, in the form of Dover's powder, fifteen grains three times a day. Five grains of quinine may be given twice a day.

Pneumonia, or Inflammation of the Lungs.

It has been definitely proved that the black races are specially susceptible to the organism which is the cause of pneumonia, and it is a frequent source of invaliding amongst the native attendants of travellers in Africa and elsewhere.

Causes.—As predisposing factors may be noted change of climate, chill, insanitary conditions of life, fatigue, and overwork. Malaria, syphilis, alcoholism, and excessive tobacco-smoking also play a part. The disease is believed to be spread by personal contact, but this has not been definitely established.

Symptoms.—These usually begin with a severe attack of shivering; the temperature rises rapidly, the pulse and breathing are greatly quickened, and the patient is completely prostrated. The face is flushed, the skin feels hot and dry, and there is a short cough, dry at first, but afterwards

accompanied by expectoration of a moderate quantity of slimy, rust-coloured, blood-stained, and almost frothless matter. Usually there is pain on the affected side, which in most cases is the right side of the chest, above the liver. In African natives heart failure is very common.

Prophylaxis.—In order to prevent the occurrence of pneumonia amongst native followers good food should be provided, properly cooked; and it is important to see that they are supplied with sufficient blankets at night if travelling through cold regions. If it can possibly be avoided natives from hot, humid localities should not be taken to chilly, elevated and wind-swept places, as under such conditions they are very apt to contract pneumonia. Overcrowding in huts or tents should be avoided, and any sore throats which develop should be promptly treated.

Treatment.—A patient attacked with pneumonia should take to bed at once. The affected side should be surrounded with a large poultice. Five grains of quinine should be given every eight hours. If the heart's action is weak, give some preparation of ammonia, as a stimulant, and administer alcohol, up to half an ounce, every two hours. Opium should only be given to calm the patient, as large doses do harm by checking free expectoration; if there is much distress, then ten or fifteen grains of Dover's powder may be given.

An ice poultice applied to the chest will give great relief by lowering the temperature and diminishing the pain (*see* page 274).

Quinsy, or Inflammation of the Tonsils.

Apply poultices to the neck. Gargle with a hot, weak solution of permanganate of potash, or a solution of chinosol (1 in 2000), at least every hour. Administer quinine and iron as a tonic. Keep the bowels well open. Surgical aid is sometimes required in bad cases.

Relapsing Fever.

This is the old "famine fever," and it occurs in various parts of the world.

Causes.—It is due to a corkscrew-shaped blood parasite, which is conveyed from the sick to the healthy by means of lice. Some hold that certain forms of this fever in Palestine, Cilicia, and Persia are transmitted by means of the common fowl tick, which often harbours

in the cracks in native bedsteads and in crevices in the walls of huts and other dwelling places.

The true tick fever of Africa, which is also a relapsing fever, is considered separately. (See *Tick Fever*, p. 241.)

Symptoms.—These differ a little in different parts of the world. The incubation period is usually from five to ten days. The onset is remarkably sudden. The patient has a chill or shivering fit, becomes giddy, develops a bad frontal headache, feels as if he had been beaten all over, and frequently vomits. He has often a difficulty in walking, and soon becomes seriously ill. Delirium is not infrequent. The tongue, unlike that in typhus fever, remains moist throughout the illness. Thirst, restlessness, and vomiting are very characteristic of the condition, and the urine is scanty. As a general rule recovery takes place, but sometimes the patient grows gradually worse and dies. As a rule, however, the temperature falls very suddenly, and the patient is better. After a week or so a relapse occurs. The temperature again shoots up, and remains up for several days. Then there is a second crisis, another relapse, and so on for perhaps three or four times. Most cases recover, and once convalescence is established the patient soon gets well.

Prophylaxis.—The disease being lice-borne, it is necessary to take all steps to prevent contact with these insects (see *Lice*, p. 196). The organism has been shown to be capable of passing through intact mucous membranes and unbroken skin. Hence it is advisable to be careful when attending a case, for the organism has been found in sweat and tears, while the patient's blood is, of course, infectious.

Treatment.—Careful nursing and a light diet. Attend to the state of the mouth and of the bowels. The arsenic preparation, known as salvarsan (kharsivan), is a specific remedy, and can cut the disease short; but it can be administered only by a medical man. Otherwise there is no treatment save the symptomatic.

Rheumatism.

This is a disease which frequently follows exposure to damp and cold, and is on that account not uncommon in the tropics. It is often hereditary. After one attack, rheumatism is always liable to recur in

the same individual, and on this account it is necessary that persons liable to the disease should use special precautions.

Acute rheumatism or Rheumatic Fever.—This is really an infectious disease due to a specific organism, and is quite different from the ordinary rheumatism of everyday life.

Symptoms.—It begins by a shivering fit, with rise of temperature and general sickness, and the joints, usually wrists, ankles, or knees, become painful, tender, and afterwards swollen. It resembles other febrile conditions in the rapid pulse and breathing, the constipation, scanty and high-coloured urine, etc., but it differs from most of them in the presence of a profuse and sour-smelling perspiration, resembling the odour of butter-milk.

Treatment.—The best remedy for acute rheumatism is salicylate of soda, of which fifteen grains should be given every six hours. The joints should, at the same time, be kept wrapped up in cotton wool, covered with oiled silk and a flannel bandage. This treatment will nearly always correct the acute symptoms in two or three days. If the symptoms subside sooner, the quantity of the salicylate should be diminished; if there is delirium, the dose must be lessened at once, for many people are very susceptible to salicylates and are easily affected by them, the delirium being characteristic. Dover's powder may be given to relieve pain and to secure sleep.

Chronic rheumatism.—In this disease there is chronic pain and tenderness of the joints, without fever.

Treatment.—Bicarbonate of potash and salicylate of soda, each in five-grain doses, should be given every eight hours. Painful joints may be painted with tincture of iodine, rubbed with turpentine liniment, or bathed with hot water. The bowels should be kept well open, and alcohol and much meat avoided.

Rupture or Hernia.

A rupture or hernia is a protrusion of some portion of the bowels under the skin, and is usually found in the groin. It is generally reducible, i.e., it can be pushed back into the belly. It reappears when the pressure is removed, especially if the patient coughs or strains. When reduced, a properly-fitting truss should be applied and worn during the day. It can be taken off at night, after lying down, but should

be re-adjusted in the morning, whilst the patient is still in bed. No patient should go abroad without having an operation for the cure of the hernia.

The great danger of any rupture is that it may become irreducible—a condition which is very likely to be followed by constriction or “strangulation” and subsequent death of the ruptured part of the bowel. If unrelieved, this constricted condition is always fatal. The existence of strangulation is known by local pain and tenderness, development of severe colicky pains in the belly (especially about the navel), absolute constipation, vomiting, hiccough, and symptoms of collapse. When this condition is observed, the patient's hips should be raised by supporting them with pillows, and the tumour should be only very gently kneaded with the view of getting back the protruded bowel. The treatment is considerably aided by immersing the patient in a warm bath, and giving about twenty drops of laudanum or chlorodyne. Ice placed round the swelling for half an hour or so is often very effective. If these means fail, surgical aid is absolutely necessary. *Purgatives should not be given.*

Sand-Fly Fever.

This disease, also known as phlebotomus fever, is very wide-spread and probably occurs in most parts of the world where sand-flies are found.

Cause.—The organism is unknown, presumably being too small to be seen by the highest powers of the microscope, but it is known to be transmitted by what are called sand-flies or pappataci flies, tiny and very hairy midges which breed in such places as heaps of damp stones, bricks, and tiles, cracks in surface soil, the walls of old cellars, cracks and fissures in embankments. These little flies, which sally forth upon the blood quest towards evening, are voracious blood-suckers, and feed principally in the gloaming and at dawn. They chiefly attack the wrists and ankles, and can easily bite through thin socks or light cotton or linen clothing. It has been proved that the bite of one infected fly can convey fever. During the day they hide in dark places, and may be found in the dark corners of rooms. Their bites are painful, and when numerous the bitten part may swell badly. An attack by many flies effectually banishes sleep.

Symptoms.—The fever is short and sharp—indeed, it is often called the three-day fever. The incubation period is four to seven days, and

the attack is sudden, beginning with chilly sensations and a tired feeling. There may be rigors, but these are never so severe as the shivering fits of malaria. The patient becomes giddy, has a severe frontal headache with pain at the back of the eyes and pains in the back and legs. The condition, indeed, is very like an influenzal attack except that there is, as a rule, no coryza. The face is flushed and the eyes may be injected. When the latter is the case one can understand how the disease was originally given the name of the "dog disease," as the appearance of the injected conjunctivæ resembles that sometimes seen in mastiffs and bloodhounds. There may be some sore throat, and sometimes there is a little eruption on the throat or palate. The temperature rises rapidly and may attain 103° F. It remains up for about twenty-four hours and then begins to fall, usually becoming normal on the third or fourth day. Sometimes there is a secondary rise of temperature. The patient may speedily recover or convalescence may be tedious, and the condition is sometimes followed by mental depression and the digestion may be upset. The fever is apparently never fatal but it is troublesome and debilitating.

Prophylaxis.—Protect from the bites of sand-flies. This is best done by the use of a fine-mesh net containing twenty-two holes to the linear inch. It should be of the same general pattern as the net recommended under malaria (*see* p. 206). Tobacco smoke keeps the flies away to some extent and repellents are useful, especially vermifelli, containing some oil of citronella, the preparation known as Sketofax, oil of cassia and oil of eucalyptus. A lump of camphor as a bed-fellow is also useful as the flies dislike its odour. The patient should always be placed under a fine-mesh net to prevent his being a source of infection to others.

Treatment.—Rest in bed, light diet, and one full dose of laudanum, *i.e.*, thirty drops, given as early as possible. Chlorodyne in the same dose may also be used. Quinine is useless and may aggravate the symptoms, but aspirin and the salicylates are helpful. If there is much pain in the muscles the application of hot sandbags may afford relief.

Scarlet Fever, or Scarlatina.

This fever is very uncommon in hot climates.

Incubation period, three to eight days. Rash appears second day.

Symptoms.—The rash consists of numerous minute red spots, evenly

distributed all over the surface of the body, upon a general rose-red blush. The area immediately surrounding the mouth is not affected. Shivering fits, sickness, high temperature, sore throat, headache, pains in the back. The sickness is very characteristic in children. After the rash has subsided, *peeling* of the skin takes place, beginning on the face as a very fine powdery deposit. The process then spreads to other parts of the body, the last places to peel being the palms of the hands, the soles of the feet, and between the fingers and toes. The peeling process takes from four to six weeks, and the patient is infectious during the whole of this period.

Treatment.—Isolation. Bed in an airy room. Light food. If the fever is high (104° F.), the body may be sponged with tepid water. If the throat is very inflamed, an antiseptic gargle should be used. As the course of infectious fevers cannot be cut short, the chief aim of treatment should be to avert complications and the return of distressing symptoms—over-treatment with drugs must be guarded against.

To prevent the spread of infection from the peeling surface, the body should be rubbed over with boracic ointment, or carbolic or olive oil.

Complications.—As scarlet fever may be followed by heart, kidney, or ear trouble, the patient should not be allowed to get up until at least ten days after the temperature has become normal.

Scorpion Sting and Spider Bite.

Scorpion sting is not infrequent in hot countries, but is very rarely fatal in the case of the adult European unless several stings have been received at one time.

Symptoms.—The usual symptoms in the adult are a brawny swelling in the region of the sting and more or less collapse. There is often severe pain of a throbbing nature, and there may be sickness and vomiting.

Treatment.—Apply a tourniquet above the sting and incise the affected area; then apply an opium lotion. This is usually sufficient to afford relief and prevent extension of the swelling. A serum suitable for use in Egypt and the Sudan only, has been prepared for treating scorpion stings, and when it is available it should be used as soon as possible, as very favourable results have been reported from its employment. It

can be obtained in Cairo or in this country from Messrs. Allen and Hanbury.

Spider bite is not so important as scorpion sting, though poisonous spiders do exist in various parts of the world and belong to a genus found in Southern Europe, New Zealand, and various parts of North and South America. Many of these poisonous spiders are brightly coloured, their abdomens being spotted with vermilion. In Peru there is a so-called "pruning-spider," which belongs to another genus and is also poisonous.

Symptoms.—Locally a reddish papule appears, and there is sharp stinging pain. The papule is followed by a spreading inflammation which sometimes goes on to gangrene, though this is rare. The general symptoms are those of nervous exhaustion and there is high fever, rapid pulse, rapid breathing, and sometimes blood in the urine.

Treatment.—Apply a ligature and suck the wound. Use permanganate of potash locally as in the case of snake-bite. The permanganate should also be given internally, one-quarter to one per cent. solution being given every hour or every two hours. Diffusible stimulants such as ammonia, caffeine, or camphor are useful as diuretics. A strict milk diet should be enforced during treatment.

Scurvy.

This is one of the deficiency diseases. This is not to say that mere general starvation will produce it, but that it is due to the lack of certain substances in the diet. These substances are known to exist in fresh fruit and vegetables, and also to a lesser extent in fresh meat and raw milk, but their exact nature has not yet been determined. Travellers should remember that, apart from the actual disease, there is a scorbutic state in which the symptoms are indefinite, and which, if not recognized and promptly treated, will pass on to true scurvy.

Symptoms.—Scurvy begins insidiously with progressive weakness, pallor, loss of weight, and stiffness in the leg muscles. Later the gums become affected, soft swellings sprouting up between the teeth. As the disease progresses the gums become swollen and spongy, ulcerate and bleed, while in bad cases the mouth becomes very offensive and contains large fungating masses. Other signs of scurvy are hæmorrhages under the skin and mucous membrane and in the muscles. Any injury is apt

to be followed by hæmorrhage. Swelling of the legs is an important symptom, especially in the region of the ankles. If untreated, the condition becomes worse, the appetite is impaired, mental depression sets in, there is breathlessness on exertion, and night and day blindness. Death results from heart failure or some complication.

Prophylaxis. — Ensure a good dietary containing sufficient anti-scorbutic elements. Wherever possible, fresh meat, fresh vegetables, and fresh fruit should be supplied. Lemon juice is valuable. It should be noted that it is four times as efficient as the lime juice which used formerly to be employed. The ration should be one ounce daily served with sugar. Germinating peas, beans, and other pulses contain the anti-scorbutic elements in large quantity. It is a simple matter to carry a supply of these pulses and to germinate them when required. The dry seeds must be whole, retaining their original seed-coat. In order to make them germinate they are placed in a clean sack and steeped in a vessel containing clean water, which should be occasionally stirred. Sack and trough should be large enough to allow for the swelling of the pulses to about three times their original size. In a hot climate six to twelve hours is sufficient for this soaking. Thereafter, lift the seeds out of the water and spread them out to a depth not exceeding two or three inches in some vessel which allows free access of air to them. Keep them moist by covering with sacking, which is wetted at intervals. The germination should reach the stage necessary within twenty-four hours in a hot climate, and the pulses should be cooked and eaten as soon as possible after germination. Care should be taken not to overcook them. At a pinch germination may be effected by placing the seeds between wet blankets, but this is a rough-and-ready method not to be recommended.

It is important to attend to oral hygiene, especially the regular use of the tooth-brush. Vegetables should never be overcooked. In the case of African native followers Kaffir beer made from germinated grain is of great value; one pint should be given daily per head. Potatoes and root vegetables are useful, and the onion is a valuable food in this connexion. Fresh meat is not so effective as either fresh fruit or vegetables.

Treatment. — This is chiefly dietetic, and the same foods and substances as are mentioned under prophylaxis are used also for the cure of

scurvy. In addition, scurvy patients should be kept in bed, given plenty of fresh air, and have the affected parts massaged. Tonics and mouth-washes are indicated, and a liberal diet with plenty of fat in it should be provided. Where fresh fruit cannot be obtained raw meat and raw fresh eggs in milk form a good substitute.

Sea-Sickness.

Take a saline aperient on the day before embarking, and a light plain meal at least three hours before going on board. A cup of good tea or black coffee soon after starting is often of use.

Those liable to sea-sickness should go to bed directly they get on board: the head should be kept low and the room darkened. A mustard leaf applied to the pit of the stomach is of value in diminishing the tendency to vomit. An abdominal belt is useful from the gentle support it gives. A hot-water bottle may be applied to the feet.

A mixture containing fifteen grains of bromide of soda and five grains of antipyrine to one ounce of water is often of great value. The first dose should be given immediately the patient is in bed, and may be repeated every six hours if required.

Whitla states that the best of all remedies is bromide of ammonium, It should be given in twenty-grain doses for a day or two before embarking. Morphia may be found necessary: a third of a grain may be injected under the skin of adults, but it should on no account be given to children.

I have found that three or four drops of chloroform, dropped on to loaf sugar and sucked, often prevents vomiting.

Those who are vomiting severely should take plenty of hot water or milk, so as to prevent them from straining on an empty stomach.

Very often raisins or raisin tea can be taken when other nourishment is rejected. A recent method of treatment which has sometimes been found effective is to plug the ears firmly with cotton-wool, but this should only be done by a medical man. It is, however, worth trying.

Skin Diseases.

Boils.—Boils are very common in the tropics and occur especially in people who have been run down. They are most frequent during

or after the rains and especially in the course of hot, damp summers. In Egypt the so-called Nile boil is quite a feature of the country. In the tropics boils are often multiple and a very favourite site is the buttocks. Any part, however, which is apt to be bathed in sweat is liable to infection. A boil on the face may apparently result from the bite of a mosquito or other blood-sucking insect.

Prophylaxis.—Protect from insect bites and treat even the most trivial of skin lesions with tincture of iodine. Keep the skin clean and change the underclothing frequently. If a boil occurs cover it with a small dressing so that other parts of the skin may not be affected. A change of climate is often the only thing that will do good in the case of a person afflicted with crops of boils.

Treatment.—It is sometimes possible to abort a boil by dipping a sharpened wooden match or a toothpick into pure carbolic acid and thrusting it repeatedly into the heart of the swelling. If the boil has somewhat developed hot fomentations and moist dressings should be applied and iodine should be painted on the skin round the boil. As a rule it is wiser not to open a boil, even when it has suppurated. It is best to let it burst and then to dress it carefully with a boric poultice, which should be frequently changed. Treatment with vaccines has come into vogue and is sometimes very helpful. Sulphide of calcium pills, one grain in each, three times a day, are often given and are said to have a prophylactic effect, but a preparation known as stannoxyl and used in the form of tablets is to be preferred. The usual dose is four tablets the first day, six the second, and eight on subsequent days. The drug is somewhat constipating. A remedy more easily obtained and which is said to be distinctly beneficial is dilute sulphuric acid. It should be taken in doses of twenty to thirty drops, well diluted, every four hours. The general health requires attention and lemon juice, plenty of green vegetables and tonics should be taken.

Carbuncles.—A carbuncle is of the same nature as a boil, but is a more serious complaint, and it is distinguished from a boil by the fact that it opens by several mouths.

To promote ripening of the carbuncle and the separation of the core or dead piece of tissue, poultices and hot fomentations should be freely

applied, and if the core can be seen it should be removed, if possible, by a pair of forceps.

To facilitate removal of the core it is sometimes advisable to cut through the skin separating the openings; there may be some slight bleeding, but it will cease after a short time.

Opium may be given to relieve acute suffering. The bowels should be kept well open. A generous diet must be given; tonics of iron, quinine and arsenic are needed, and alcohol may prove necessary.

Carbuncles rarely appear except in people much broken down in health, and their presence is an indication that the sufferer should return to his own country and seek skilled advice.

Chigger.—The chigger is not itself a disease but is a sand-flea producing a condition known by the long name of dermatophiliasis. It is a veritable pest in parts of South America and all over tropical Africa. The insect is like the common flea but smaller, lives in dry sandy soil and sucks the blood of mammals, especially pigs. After impregnation the female burrows into the skin of a mammal or bird, and, nourished by blood, proceeds to ovulation. Her abdomen becomes filled with ripe eggs and enormously distended till it looks like a small pea. Eventually the eggs escape through the opening of the skin and hatch into larvae which in due time become adult fleas.

Symptoms.—In man the feet are the part most frequently affected, the chiggers being found between the toes and under the toe nails. When people sleep on the ground other parts of the body may become affected and large numbers of chiggers may be present at one time. There is itching and irritation at the place of invasion, and when the latter is examined a little dark dot will be seen. This is the posterior end of the female flea, which is lying head downwards in her burrow. If not removed suppuration occurs round her distended abdomen and the skin gets much inflamed and swollen. When the eggs have been discharged ulceration takes place and the flea is expelled. A small sore, however, is left which is very liable to get contaminated, and, if neglected, may lead to very severe complications.

Prophylaxis.—Do not camp in the neighbourhood of native villages. Clean the camping ground thoroughly and, if necessary, fire it. As insecticides flaked naphthalene or a strong infusion of native tobacco are

useful. The latter may be used inside boots or shoes. Walking barefoot should be avoided, as should sleeping unprotected on the ground. In the case of native carriers or porters a daily foot parade should be instituted. Some protection is afforded by smearing the feet, especially the spaces between and under the toes, with a preparation like phenofax or with a mixture of five drops of lysol or cresol and an ounce of vaseline.

Treatment.—It is usually better to get a native to remove a chigger as long practice makes them very expert in the little operation. The latter consists in widening the skin orifice with a sharp clean needle, and freeing the flea from the surrounding tissues in order to get it out whole. If it ruptures forceps must be employed, and this is much more painful and difficult than extracting the entire insect. The infected parts should be carefully treated antiseptically.

Fungus Diseases.—There is a great number of tropical diseases due to fungi but only a few can be considered here, and these only very briefly. (1) *Dhobie Itch* is one of the best known and is so called because it was thought to be derived from clothes infected by the persons (dhobies) who washed them. The parts usually attacked are the groins, the upper part of the thighs and the armpits. The condition is due to a fungus like that of ringworm and the skin becomes red and raised and somewhat scurfy. Dhobie itch causes great irritation and is sometimes associated with considerable pain.

Treatment.—Mild cases are best treated by using an ointment containing resorcin two drachms, salicylic acid ten grains, and vaseline and lanoline, of each four drachms. The parts may be painted with iodine but this is somewhat irritating. An ointment of ammoniated mercury, two to five per cent., is often effective. Bad cases require the application of araroba (chrysarobin) ointment, but it should not be used unless recommended by a doctor. Goulard water or Wright's liquor carbonis detergens (one tablespoonful to two pints of water) are soothing applications.

(2) There is a fungus disease of the hairs, especially of the armpits and the pubis, which occurs in tropical climates and is often very troublesome. The hairs assume a coated, beaded or nodular appearance and the deposit on them varies in colour and may be black, yellow or

red. The underclothing in contact with the affected parts becomes stained and when the disease spreads to the skin, as it often does, the latter becomes inflamed, thickened and painful.

Prophylaxis.—Keep the axillae shaved. It is always well to do so in a tropical climate. Filing this, dust with a mixture of powdered sulphur and fuller's earth, equal parts. Change the underclothing frequently and bathe the parts liable to infection.

Treatment.—Apply twice daily a lotion containing one drachm of formalin in six ounces of rectified spirit, and at night rub in a two per cent. sulphur ointment. If these measures fail apply tincture of iodine, except in cases where the skin is involved. In such cases bathe with cold water and employ a dusting powder or a soothing lotion.

(3) *Ringworm* of the head is a disease due to a fungus. The part for some distance round the affected area should be shaved, and any stumps of hairs pulled out. The skin should be lightly painted with tincture of iodine or strong solution of carbolic acid (one in ten of water); or sulphur, white precipitate, or mercurial ointment may be gently rubbed in.

Kraw-Kraw.—This is a term commonly employed by natives of the West Coast of Africa to indicate almost any kind of itchy, papular, or pustular eruption. Many of these appear to be contagious, and most of them are best treated by opening up any pustules which may be present, removing crusts by boric poultices, and scraping ulcers. Then scrub thoroughly with sublimate lotion 1 in 1,000, dust with boric powder and apply a dressing of medicated vaseline. The application should not be disturbed for a week when, as a rule, the skin will be found to have healed up. Clothing and any other articles which have been in contact with the affected parts should be destroyed or thoroughly disinfected.

Prickly Heat.—This condition is very frequent, especially in the moist tropics. It is due to free sweating, and is accompanied by intense heat and itching. The parts closely covered by clothing are specially apt to be affected. The skin becomes covered with numerous slightly inflamed papules, set close together, and the eruption may remain for months at a time, varying in intensity according to circumstances.

Prophylaxis.—Avoid long drinks, warm clothing, too much exercise, and all conditions producing excessive perspiration. Sea-bathing should be avoided, and soap should not be used in the bath. One should sleep under as hygienic conditions as possible, with a well-ventilated bed and without unnecessary clothing. A dusting powder of equal parts of boric acid, oxide of zinc, and starch is useful.

Treatment.—Ryan strongly recommends the so-called "Sulphaqua" bath charge, which is sold in packets ready for use. The above-mentioned dusting powder is helpful, as is the application of a lotion containing salicylic acid and spirit. Some prefer oily applications. Whatever is used, care should be taken to see that the bowels are well opened at the beginning of an attack, preferably by a saline purge.

Ulcers.—Ulcers are often very troublesome to the traveller, as the healing process is frequently retarded by exposure, dirt and dust, and the chafing of clothes. Want of sufficient animal food greatly favours the spread of large ulcers.

A simple dressing of iodoform ointment, or ointment of boric acid, is effective when the ulcer can be protected, and rest can be given to the affected part. When the ulcer is deep and large it may be stimulated to heal by the application of lint or cotton-wool, moistened with carbolic oil, carbolic lotion, or other antiseptics.

Large, unhealthy ulcers should be well bathed with some antiseptic such as carbolic acid, one in sixty of water, or a solution of chinosol (1 in 800); and after the sore has been cleansed it may be lightly dusted with iodoform and then covered with a piece of lint moistened with carbolic oil or smeared with iodoform ointment and supported by an evenly applied bandage. Boric ointment, lano-creoline, izal ointment or other antiseptic dressing may take the place of iodoform ointment.

In addition to the above general account, certain conditions leading to ulceration require consideration.

Oriental Sore.—This condition is commonly known as Baghdad Boil, Aleppo Button, Frontier Sore, etc. It occurs in various hot countries, such as Egypt, Syria, Asia Minor, Arabia, and Mesopotamia, and has been met with in Europe and Greece. A special form affecting both skin and mucous membranes is widely distributed in South America.

Cause.—The cause is an organism to all appearances identical with that which produces leishmaniasis or kala-azar. Indeed, Oriental sore is a form of cutaneous leishmaniasis. In all probability infection is conveyed by sandflies, but our knowledge is still defective on this point.

Symptoms.—The incubation period varies from a fortnight to a year. The sore may occur on any exposed part of the body, but is most common on the forearm, hands, and face. Multiple sores are frequent. The first sign is a small red, scaly papule, which increases in size and eventually breaks down, forming a painless ulcer, with a hard, dry edge. Non-ulcerating forms occur, but are not common. The condition is very chronic, but healing usually sets in after six to twelve months. When the ulcer heals a white or pink scar is left, which is disfiguring.

Prophylaxis.—Sleep under a sandfly net, containing 22 holes to the linear inch. Warn against the danger of infection by personal contact and the risk of re-infecting oneself by scratching. It is advisable to paint the sites of all fly and insect bites with iodine as soon as possible.

Treatment.—The best treatment at present known is intravenous injection of tartar emetic. This, of course, can be carried out only by a medical man. Good results have, however, been obtained by applying a 2 per cent. ointment of tartarate of antimony, and this method can be carried out by the patient himself. Local injections of emetine have been recommended, and there are various other ways of treating Oriental sore, but they need not be here considered.

Tropical Ulcer.—This is a special and serious form of ulcer found in all parts of the world, and especially amongst East African natives. It is found chiefly in the lower third of the leg and in the region of the foot and ankle.

Cause.—This is somewhat obscure, but it is believed to be due to certain organisms possibly acting in association with one another.

Symptoms.—The condition starts as a small, tender, and often itchy papular bleb, surrounded by a dense inflammatory zone. An ulcer results, which is more or less painless, and one of the characteristics of which is the way it spreads and destroys all the tissues with which

it comes in contact. It is often mistaken for a syphilitic ulcer, but it does not usually yield to anti-syphilitic remedies.

Treatment.—The best remedy would appear to be formalin, though the iodoform ointment mentioned under ulcers may aid the condition. It can be effectually treated only by a medical man.

Veldt Sore.—This condition, which is also known as Barcoo Rot, is frequently in evidence in countries with hot, dry climates, as, for example, Egypt, Palestine, South Africa, Mesopotamia, etc.

Cause.—It is due to certain bacteriological organisms, and is apt to occur in persons who are debilitated, who are not receiving proper food, or who are living under conditions where it is not easy to keep clean. Some think the sores are commonest in men who have to deal with horses.

Symptoms.—Veldt sores are most common on the hands and forearms. They begin as itchy papules, which become blebs, then pustules, and finally ulcers. They are usually multiple, and when they heal they leave areas of thin, glossy skin.

Prophylaxis.—As for boils.

Treatment.—The spread of ulcers can be checked by removing the hairs from their bases and round their margins. Very often the ulcer can be started on its healing process by employing dressings soaked in a solution of 1·5 per cent. sodium citrate and 20 per cent. common salt. Vaccines are often successfully used in this condition, and the stannoxyl mentioned under boils may be employed, as may a salicylic acid ointment, 20 grains to the ounce.

Sleeping Sickness.

This is the old "Negro lethargy," and must not be confounded with what is now called sleeping sickness in the British Isles and on the Continent, which is quite a different disease. True sleeping sickness is limited to Africa, and there are two chief types: that occurring in parts of the West Coast and the French and Belgian Congos, in Angola, in portions of the Anglo-Egyptian Sudan, in Uganda, and in parts of the Tanganyika territory; and that which occurs in Northern Rhodesia, Nyasaland, Portuguese West Africa, and the region of the Rovuma River.

Cause.—The cause is a tiny animal blood parasite conveyed from the sick to the healthy by certain species of tsetse flies. In the tsetse fly the parasite, which is called a trypanosome, undergoes a definite development.

The two species of tsetse fly meriting special consideration here are *Glossina morsitans* and *Glossina palpalis*. The former, as a rule, occurs in thin, deciduous bush, or low, comparatively open forest, while the latter haunts the neighbourhood of streams and lakes, and is rarely found any great distance from the water edge. These flies are about the size of a small blue-bottle, but are not so stoutly built and, when closed, their wings overlap and project beyond the end of the abdomen. *Glossina morsitans* is brownish coloured, with bands on its abdomen. *Glossina palpalis* is much darker, indeed almost black-looking. They have a quick and darting flight, and are attracted by rapidly-moving objects, like motor-bicycles and motor-cars. Once they alight they do not move about. As a rule they bite only during the day, but they may attack man on bright moonlight nights.

Symptoms.—The incubation period is probably about three weeks. The fly bite may be painful, and causes a slight local irritation. The disease begins insidiously, with an irregular fever, and there may be a skin eruption. The fever comes and goes, and the patient gets weaker and suffers from headache. The glands in his neck and possibly in other parts of his body become enlarged and may be tender. The first stage of the disease is called trypanosome fever, and may end in recovery. More usually the central nervous system becomes affected; and then the symptoms of true sleeping sickness develop, slowly or with considerable rapidity. The patient becomes dull and drowsy. Both his speech and movements are affected. His face gets puffy, and he shuffles when he walks. He still has fever, continues to lose flesh, and gradually passes into a sleepy condition, which may be associated with convulsions. Saliva dribbles from the lips, and half-masticated food may remain in the mouth. The patient becomes helpless and indifferent to his surroundings, and either dies from coma or from some intercurrent disease, such as pneumonia or dysentery.

Prophylaxis.—Personal prophylaxis consists in avoiding being bitten

by tsetse flies. When passing through fly belts in affected areas veils and gloves may be worn.

Treatment.—If taken in time sleeping sickness can be readily cured by the use of the arsenical preparation atoxyl, combined with antimony. The course of treatment, however, extends over a considerable period, and it must be carried out under the supervision of a medical man.

Sleeplessness.

This is common in those broken down by malaria, dysentery or debilitating diseases; it is also induced by the irritation caused by mosquitoes and other pests, such as the itch parasite. It is at times due to errors of diet, prickly heat, mental worry and exhaustion, abuse of tea and coffee, coldness of the feet and indigestion, and as most acute diseases are worse at night, sleeplessness is very common amongst sick people.

Treatment.—As far as possible remove the cause; kneading the feet and legs, or the application of a hot-water bottle to the feet, will often be of service. A cup of hot milk or soup should be taken at bed-time, and again on waking in the night. The bowels must be regulated and alcohol taken very sparingly.

The taking of sedative drugs should be avoided as much as possible. The least harmful of these is sulphonal in doses of from twenty to thirty grains, given several hours before bedtime, or bromide of potassium in twenty or thirty-grain doses given at bedtime. A warm bath at night often acts more satisfactorily than any other remedy. Only very rarely should chloral, chlorodyne, or opium be resorted to.

Regular habits and plenty of work are potent factors in the production of that healthy condition which predisposes to natural refreshing sleep.

The unfortunate man who has no hard work to do, who is without even a hobby to occupy him, and has no interest in life but the torpid condition of his liver, is a constant sufferer from insomnia. He should be purged and put on a light plain diet. Alcohol must be forbidden and plenty of exercise must be taken. A tumblerful of hot water is to be taken the first thing in the morning and the last thing at night.

Smallpox.

Very prevalent in the tropics, hence the importance of revaccination before going abroad.

Incubation period, twelve days. Rash appears third day.

Rash.—Before the appearance of the typical rash there are occasionally earlier rashes, viz., a diffuse blush covering the whole body, resembling scarlet fever, or a dark purple rash of effused blood beneath the skin of the lower part of the belly, or occasionally in the armpit. The smallpox rash proper consists of small red raised spots which first appear on the face, forehead, and scalp, subsequently coming out over the rest of the body, commencing at the top and working downwards. These spots become prominent, and have a characteristic "shotty" feeling under the finger. On the third day after their appearance a small bleb forms in the centre of each spot; it is transparent at first, but subsequently becomes yellowish, from the formation of matter in its interior. The centre becomes depressed on the sixth day, then the bleb breaks down, and discharges matter. Two or three days later the spot begins to dry up, and ultimately heals under a scab. During the period of most active inflammation the face may be very swollen and sodden.

The spots and pustules are not confined to the skin, but may occur on the roof of the mouth and in the throat.

Prophylaxis.—This consists in efficient vaccination, and as travellers may themselves have to carry out the technique of vaccination, it is important they should know something about it. The usual faults in technique are a lack of cleanliness, resulting in sepsis, the use of too strong an antiseptic when cleaning the skin, overheating of the lancet, needle or scarifier when purifying it, drawing too much blood, which washes away the lymph, exposure of the recently vaccinated area to the hot sun, and charring of the lymph in the capillary tube when sealing. All that is necessary is to clean the part to be vaccinated with soap and water, using a nail-brush, then rub the skin with alcohol, and when the latter dries proceed with the little operation. There should be four incisions, and the total area which will eventually be occupied by the vaccine vesicles should not be less than half a square inch. It may be noted that the vesicle is fully ripe on the seventh day after vaccination.

Treatment.—Isolation, similar to that of scarlet fever. The body may be sponged and vaseline applied if there is much itching. The eyelids and eyes should be frequently washed with weak boric acid solution.

Snake Bite (see p. 281).

Sprue.

This is a chronic form of tropical diarrhœa, often called "white diarrhœa," the leading symptom of which is the frequent passage of large, frothy, and pale-coloured motions; dyspepsia, and soreness of the tongue and mouth, are also present, and there is marked anemia and advancing debility. The disease may follow attacks of diarrhœa or dysentery.

Cause.—The actual cause of sprue is unknown, but the disease usually develops in persons who have been for some considerable time in the tropics, and it is commoner in India, Ceylon, and the Far East than elsewhere.

Treatment.—Put the patient to bed, give a simple aperient such as castor-oil, to clear out the bowels; allow only a milk diet, to which, as the symptoms begin to abate, meat juices and jellies should be cautiously added. If any other disease, such as scurvy, is present, it must be treated. Drugs are not usually of much service; however, a mixture containing bismuth, soda, and one drop of carbolic acid in an ounce of gum-water may be given three times a day for a week. The soreness of the mouth and tongue may be treated by the application of borax and glycerine, or mild antiseptic mouth washes, such as a weak solution of permanganate of potash, or a lotion of boric acid. Special symptoms, such as pain and collapse, must be treated as they arise. As soon as the patient is strong enough, he should be removed to a temperate climate.

Stroke, or Apoplexy.

This disease is caused by the rupture or blocking up of one of the blood-vessels in the brain.

Symptoms.—The person attacked falls down suddenly, and is unable to move one or more of his limbs. He may be quite insensible, or soon become so, or perhaps he is unable to talk. The mouth may be drawn

to one side, and the tongue, when protruded, be pushed to the right or left. The condition is serious.

Treatment.—Tight clothing must be removed. Six grains of calomel powder should be placed on the back of the tongue, and the patient kept lying on his back with the head slightly raised. Cold should be applied to the head and a hot-water bottle to the feet, the room darkened, and absolute quiet observed. An enema of hot water may be given, and while the patient is insensible the lips should be moistened only with water. Food may be given by the bowel on the second or third day. Stimulants are absolutely forbidden. If the patient gets over the attack he ought to be sent home.

Note.—It must not be forgotten that many of the above symptoms might be caused by injury or poison.

Sun-Stroke and Heat-Stroke.

These conditions are distinct. Sun-stroke, which is comparatively rare, is due to the direct action of the sun on the brain and spinal cord. Heat-stroke, on the other hand, would appear to be due to the lack of escape of heat from the body, owing to insufficient evaporation from the skin, and to the effect of muscular fatigue. As a result, poisonous substances accumulate and act detrimentally upon the nerve cells. There is also a deficient supply of oxygen to the blood. High relative humidity plays a very important part in producing attacks of heat-stroke. The milder forms are known as Heat exhaustion and Heat prostration; the severe form is often associated with true sun-stroke.

Symptoms.—Heat exhaustion is really a form of faintness, and recovery soon takes place after a rest. The symptoms of heat prostration are giddiness, often associated with nausea. The patient is bathed in a clammy sweat, his pulse is thready, his breathing shallow, and, it may be, sighing. The condition may pass into unconsciousness, but the temperature is not raised, and death rarely results.

There are two kinds of true Heat-stroke; one a form with high temperature, the other what is called Heat cramp, which is common amongst ships' firemen in the tropics. An early warning sign of heat-stroke is a desire for frequent micturition, and other premonitory symptoms are a dry skin, giddiness, drowsiness, headache, and intolerance of light. The pulse becomes quick and irregular, the skin is

hot and dry, and the temperature elevated. The patient may become comatose, or exhibit delirium or convulsions. There is an asphyxial type, in which the face becomes cyanosed and the breathing is in abeyance.

Prophylaxis.—Avoid severe exercise in a hot sun. Wear suitable clothing, which should be loose and easy, and protect the head, and especially the nape of the neck, from the sun's rays. Dark or tinted glasses are useful. Water should be taken freely, and the bowels kept open; but alcohol must be avoided. Sniffing a mixture of water and vinegar and damping the face are helpful measures.

Treatment.—In the case of Heat prostration the patient should be laid in the shade on his back, his clothes should be loosened, his limbs massaged, and, if he is collapsed, stimulants in the form of ammonia or camphor should be administered. The asphyxial type of heat-stroke can only be treated by means of artificial respiration, which may have to be continued for as long as a couple of hours. The ordinary form, which has been called the paralytic type, must be treated promptly and vigorously. One must aim at reducing the temperature, getting rid of the toxic material in the body and preventing heart failure. Probably the best way of treating the condition as an emergency is to lay the patient naked on an inclined plane and drench him with cold water. When doing so it is well to take the rectal temperature, and to stop this chilling process when the thermometer registers 102° F. After the drenching wrap the patient in blankets and apply hot bottles to the trunk and limbs. An ice bag, if available, should be applied to the head, which in any case should be swathed in cold cloths. It should be noted that in the absence of ice, a sheet soaked in cold water or dilute alcohol, over which a draught of air plays, is a useful substitute. A fan may be used to create the air draught. Auxiliary methods of treatment can be efficiently carried out only under medical supervision. As soon as the patient has recovered somewhat, a dose of calomel should be given, followed by salines.

Syphilis.

Syphilis, or the Pox, is an infectious venereal disease, nearly always communicated by direct contagion. The course of the disease is marked by a primary sore, the chancre; early constitutional (secondary) symptoms, and late constitutional (tertiary) symptoms.

In primary syphilis the disease is limited to the part or organ originally infected, and the glands connected with that spot. After an incubation period of from three to six weeks a small painless pimple appears at the seat of infection; it breaks down, and forms a small ulcer from which oozes a little watery fluid. The base of the ulcer and the skin surrounding it are hard like gristle. The nearest glands, usually those of the groin, enlarge and occasionally become tender. Unless badly neglected, the original sore gradually heals and the glands resume their normal size. Secondary symptoms now make their appearance. These are fairly definite, and comprises (a) A skin rash, consisting of numerous irregularly shaped copper-coloured spots, spread over the face, upper part of the chest, the loins and the back of the arms. They do not itch. (b) Moist lumps and warts form in the crutch, around the scrotum (purse) and the outlet of the bowel. (c) Ulcerated sore throat. Large deep ulcers form on each tonsil, having ragged undermined edges. (d) Iritis or inflammation of the eye may also occur. These symptoms, even if untreated, tend to heal, but always leave more or less marked traces behind.

The discharge from either primary or secondary sores is infectious and may convey the disease, so that great care needs to be taken in handling such sores.

After an interval of apparent health, lasting perhaps only a few months, but often for a year or two, the tertiary symptoms or "reminders" make their appearance. These take the form of localised swellings, which soon break down, forming deep ulcers, and if untreated, produce extensive destruction of the part involved, with much deformity.

Prophylaxis.—The methods available are now so well known that they need not be discussed in a work of this kind. Mention need merely be made of the fact that in some foreign countries, owing to unhygienic conditions, there is a greater liability to contract the disease by what may be called unusual methods, and therefore every care should be taken to prevent such sources of infection, as, for example, the contaminated seats of closets, etc.

Treatment.—As soon as the disease is recognised, the treatment must be commenced.

Local treatment.—Keep the sore perfectly clean by washing it with an antiseptic solution such as chinocol (1 in 1000). Between the washings,

dress it with a piece of lint soaked in "black wash," or dust it with iodoform powder and cover it with a piece of lint smeared with boric ointment.

For the sore throat, use an antiseptic gargle (*see* Ulceration of Throat, p. 244).

General treatment.—The patient must be put on a course of mercury at once. Calomel, one grain twice a day, or grey powder, one grain three times a day, must be administered, and continued until skilled advice can be obtained. The effect of the mercury must be carefully watched, and if the patient complains of soreness of the gums, a coppery taste in the mouth and excessive flow of saliva, the dose must be reduced or the administration of the drug stopped until these symptoms have disappeared. If the calomel or grey powder causes looseness of the bowels, five grains of Dover's powder may be added to each dose.

In some cases, the addition of three grains of the iodide of potash to each grain of calomel does good from the very first.

For the later symptoms, continue the mercurial treatment, and give at least five grains of the iodide of potassium three times a day.

Since the above was written the whole treatment of syphilis has been revolutionized by the introduction of certain organic arsenic compounds as therapeutic agents. Of these the best known is the German salvarsan, represented in this country by kharsivan, the so-called "606." Treatment with arsenic has now largely replaced the old method with mercury; but it cannot be carried out except by one having medical training, and so need not be further considered.

Tick Fever.

One of the diseases which may be produced by the bites of insects is a form of fever, conveyed by the bite of a tick, which is common in many parts of Africa. This produces a series of symptoms which are similar to those found in the disease known as relapsing fever, which has been known to occur even in the United Kingdom, and which used to be called "famine fever" (*see* p. 218).

Cause.—The cause is a corkscrew-shaped organism found in the blood, and its vector is the tick above mentioned, which in its adult state and unfed is roughly about the length of a finger-nail, that is, four-tenths of

an inch. It is of a greenish brown colour, and is covered by a leathery integument, which looks as if it was spotted all over and which is grooved in several places. When the tick is gorged, these grooves disappear. A gorged female tick may be well over half an inch in length, and very nearly of an equal breadth.

The tick lives in native houses and in rest houses, especially along caravan routes. At night it sallies forth in search of blood, but during the day it conceals itself in cracks and corners in the walls and floors, and sometimes in cracks in native wooden bedsteads. Its bite is painful, but the infection takes place not through the bite, but as a result of the infected excreta of the tick contaminating the tick bite. One tick is sufficient to cause infection.

Symptoms.—The chief symptoms are those of a severe attack of fever, ushered in by a shivering fit and acute symptoms such as are usually found in cases of fever, for example, pains in the back and limbs, rapid pulse, and sometimes severe vomiting and diarrhoea, frontal headache, and painful bloodshot eyes are rather characteristic. The fever, which is of the relapsing type, generally keeps up for about a week, after which there may be an interval without fever for a few days, to be followed later on by another attack of fever. There are usually several relapses. As many as eleven have been noted.

Prophylaxis.—Avoid sleeping in native huts and rest houses which have been occupied by natives. Do not sleep on the ground or on wooden native bedsteads. If the latter have to be used, their legs should be smoothed to prevent ticks from climbing up them. In badly infested places, it is well to employ a hammock. A mosquito-net is useful, as it excludes the ticks; and it is well to make use of a night-light, which also keeps them away. Packs and blankets should be periodically inspected to see that they do not harbour ticks. If one has to camp on an infected area, the ground should be fired and the floors of huts dug up and thereafter removed and buried or treated with fire, care being taken that the ticks do not escape during the process. Wandering ticks can be kept away from a tent to some extent by digging round it a trench and filling it with wood ashes.

Treatment.—This is mainly symptomatic. Careful nursing is required together with a light diet. In some cases the arsenic preparation known as salvarsan (kharsivan) is found of value, but the specific treatment

of this malady can only be carried out by a medical man. In many cases digitalis or strophanthus is required, owing to the risk of heart failure.

Typhus Fever.

This disease is not so common in the tropics, but in certain sub-tropical countries, such as Egypt, it frequently occurs, and it is of course closely associated with military operations in the field.

Cause.—The exact nature of the infection is as yet unknown, but the disease is transmitted by lice, both the head and the body louse having been proved to be carriers of the virus.

Symptoms.—Incubation period 5 to 14 days, as a rule 12 days. Symptoms vary, but at first somewhat resemble those of an influenzal attack without the cold in the head. The patient is feverish and uncomfortable, but not until the third day do the typical symptoms of typhus make their appearance. Then the patient's face becomes flushed and his eyes congested, his pulse rate increases, and very soon his temperature rises and runs up to 103 or 104° F. The rash, which varies in type, generally appears on the fifth day, being found first on the upper part of the abdomen. It does not occur upon the face, but is usually very profuse on the back. If the rash develops the patient becomes seriously ill, and all his symptoms are intensified. He becomes dull and lethargic, his mouth is foul, and his general aspect is somewhat like that of a drunken man. His voice becomes husky, his hands are tremulous, and his breathing is rapid. In the second week, in most cases, he becomes delirious or comatose, and lies in bed more or less like a log. In cases that recover, improvement sets in about the fourteenth day, and is usually rapid and complete. In cases which die the temperature remains high or rises, the general condition becomes worse, and death usually takes place from heart failure.

Prophylaxis.—Get rid of lice according to the methods detailed on page 196. Those attending typhus patients should be protected from lice by wearing overalls, etc. Patients suffering from typhus should be thoroughly cleansed, their hair cut or shaved, and completely cleared of lice. Bedding and clothing must be disinfected.

Treatment.—Good nursing is of more importance in this disease than the administration of drugs. The mouth must be kept in a good

condition, and the food must be strengthening, nourishing soups being indicated. It is important to give the patient as much fresh air as possible, and as a rule he will require stimulants, especially heart tonics such as digitalis or strophanthus. Other measures can be carried out only under medical supervision.

Ulceration of the Throat.

Gargle with a weak antiseptic solution such as permanganate of potash or chinocol. An astringent gargle may be made by dissolving five grains or more of tannin in two ounces of hot water. Sulphate of iron can be used for the same purpose, two grains or more to an ounce of water. If there is much pain, apply poultices to throat.

If due to syphilis give one grain of calomel and three grains of iodide of potassium, twice a day, in addition to the local treatment. Khursivan, or similar treatment, is also indicated (*see* p. 240).

Undulant (Malta) Fever.

The term Undulant Fever is applied to Malta Fever partly because the latter is not a good name, as the disease occurs in various parts of the world, and partly because the term Undulant affords a good description of the type of the temperature curve.

Cause.—The organism is a small bacterium, which is found in the blood and tissues. Although theoretically the disease can be spread like enteric fever or dysentery, in practice it is found that it is nearly always conveyed by infected goats' milk. Goats are apt to harbour the organism and excrete it in their milk. It is also found in certain milk-products, such as cream and cheeses which are not allowed to ripen. In addition to man and goats, cows, sheep, horses, mules and dogs, are all liable to natural infection.

Symptoms.—Incubation period 5 to 15 days. The disease begins with headache, malaise, anorexia, and sleeplessness. The patient is usually constipated, and there is tenderness in the splenic region, the spleen being enlarged at an early date. The temperature rises gradually for three or four days in a step-like manner, and then falls by a similar descent, reaching the normal on or about the tenth day. At this early

stage bleeding from the nose may occur, and profuse night sweats are not uncommon. The tongue is flabby and coated. When the temperature falls the patient feels better for a few days, but is still apt to suffer from night sweats, and continues to lose flesh. A relapse occurs, and is usually accompanied by joint troubles and sometimes neuralgic pains. A series of febrile waves continues to follow each other at short intervals, and the illness is a very wearisome one, running an average course of 60 to 70 days. It may, however, extend for nearly a year, and in some cases terminates fatally. The long course of the illness results in the patient becoming anæmic, and he often suffers from mental depression. There are irregular forms of the fever which are apt to be puzzling, and it is always well to remember that any cases of prolonged pyrexia from tropical or sub-tropical regions may be Malta fever.

Prophylaxis.—Avoid drinking goats' milk and eating the local products of such milk. If goats' milk must be drunk it should be boiled. General hygienic measures are also important, and it should not be forgotten that the organism of the disease is found in urine, which should therefore be disinfected.

Treatment.—This is for the most part entirely symptomatic. Medical attention and good nursing are essential. A vaccine has been introduced and is worth trying, but vaccine treatment is best left to an expert. It is sometimes necessary to give morphia for the joint pains and the neuralgia, but there is a distinct risk of the patient's acquiring the morphia habit. Sleeplessness, which is often troublesome, should be treated as indicated on page 285.

Urine, Retention of.

Retention of, or inability to pass the water may be caused by stricture, injury, shock, spasm, inflammation of some part of the passage, the effects of drinking, or by chill.

Symptoms.—The bladder is unable to expel its contents and it gets fuller and fuller; it can be felt in its distended condition as a painful, soft swelling in the lower part of the belly, below the navel, underneath the skin and muscles. There may be fever, great pain and constant desire to pass water, with inability to do so. When the bladder becomes greatly distended, there is usually slight dribbling of water, which is

somewhat misleading, as the case may be considered, not one of retention but rather of too frequent passing of urine.

Treatment.—Give a saline purge such as Epsom salts, three or four teaspoonfuls, and let the patient sit in a bath of hot water. If not relieved very quickly, then pass a *clean* catheter into the bladder, and allow it to empty itself (*see* Catheters, p. 272). After the bladder has been emptied put the patient to bed and give a dose of opium or bromide of potassium to procure rest. When he desires to pass water again let him have another bath, and if this is not effectual, again withdraw the water through a catheter. Patient should be careful to ward off further attacks by avoiding chills, over-drinking, and other exciting causes. If there is inflammation of the bladder, copaiba or sandal-wood capsules should be used; if the urine is irritating, bicarbonate of soda must be given.

Urine, Suppression of.

In this serious condition no urine is secreted by the kidneys, so that on passing a catheter the bladder will be found to be empty.

Causes.—Shock from injury, inflammation and blocking up of the kidneys. Suppression of the urine is a common complication of severe cases of blackwater fever.

Treatment.—Hot baths, hot poultices to the loins, free use of aperients, especially Epsom salts and other saline purges. Bicarbonate of soda in full doses. Keep the skin acting freely by means of sweet nitre, or Warburg's tincture, or five-grain doses of antipyrine. Injections of hot water into the lower bowel.

Worms.

Worms are introduced into the system chiefly by means of dirty water or imperfectly cooked food.

In the case of hook worms (ankylostomes), contaminated soil is the chief medium of infection.

Of the worms which live in the bowels the most important are the following:—

Tapeworms.—These worms may measure many feet in length; and their presence in the body can only be certainly known by the appearance

of some of the segments or portions of the worm in the motions although hunger and dyspepsia may be complained of.

Treatment.—Administer a good aperient overnight so as to empty the bowels; after the aperient nothing should be given by the mouth for eight hours, then give sixty to one hundred and twenty drops of the liquid extract of male fern in one ounce of thin gruel, milk, or gum water, and follow this up in four hours by a good meal, and an aperient to remove the worm, which should now be dead.

When the extract of male fern is not available, one tablespoonful of the oil of turpentine may be used in its place.

If later on fresh segments appear in the motions, then the treatment must be repeated.

Round Worm.—The round worm resembles the garden worm and is several inches in length; it may be observed in the vomit but more commonly is seen in the motions. The symptoms are similar to those caused by the tape worm and the treatment is the same, except that, instead of the male fern, two to five grains of santorin should be given in a little milk; and the treatment repeated every other day for a week.

Threadworm.—The threadworm is a small round worm usually measuring less than half an inch in length; it inhabits the lower end of the bowel and causes great heat and itching about the outlet, especially at night.

Treatment.—Wash out the lower bowel and inject into it about a third of a pint of tea, or a similar quantity of water containing one teaspoonful of salt, tannin, or alum; then apply a little mercurial ointment around the outlet to diminish irritation. This should be done every third day till the worms have disappeared from the motions.

The Guinea Worm.—The guinea worm often measures several feet in length; it chiefly causes trouble in the feet, ankles, and legs, where in order to obtain an exit from the body it penetrates the skin, causing a small ulcer at its point of exit.

Usually the presence of the guinea worm is attended with inflammation and the formation of matter.

Prophylaxis.—Infected persons should be kept away from water supplies, and such sources of water supply as wells and water holes should be protected. In areas where guinea worm occurs, all water

should be boiled. If this cannot be managed, it should be filtered through a piece of clean cotton cloth, as this will remove from it the small crustacean in which the larva of the guinea worm develops. Another method of treating infected water is by means of permanganate of potash, one ounce to every 2,000 gallons of well water. Caustic potash and quick-lime are also effective.

Treatment.—When the worm can be seen at the base of the little ulcer, it may be secured to a piece of match and a small portion may be wound on to the match daily. If attempts are made to forcibly draw it out, it will probably break and violent inflammation will result. During the time that the worm is being wound out, the part should be kept very clean and an antiseptic ointment applied.

There are other methods of treatment, but these can only be carried out under medical supervision.

The Hook Worm.—This is the American name for one or other of the species of ankylostomes which infect man. The disease they cause is known as ankylostomiasis, and it is common in many parts of the world, especially in the tropics. It chiefly affects natives, owing to their habits; but it occurs also in Europeans.

Cause.—Hook worms are small, almost cylindrical worms, which inhabit the human small intestine, to the wall of which they attach themselves by means of their mouths, which are furnished with formidable hooks and lancets. They suck blood, and the symptoms they produce are due in part to loss of blood, in part to the destruction of the lining membrane of the bowel, and possibly also in part to the effects of a poison which they are believed to excrete. Their eggs are passed in the excrement, and develop in the infected soil into larvae, which are able to penetrate the unbroken skin if they come in contact with it. This is the most important route of infection, but it may occur also by means of infected drinking water and from contaminated food.

Symptoms.—The most marked feature of the disease is anæmia, which is often associated with digestive troubles. Palpitation of the heart and shortness of breath are frequently met with. In bad cases the appetite is disordered or depraved. The patient becomes pot-bellied, and there is swelling, chiefly about the face and ankles. The face is frequently puffy, and the skin assumes a peculiar earthy hue. It should be noted that a very early symptom is what is called ground

itch. This is a skin eruption, usually on the feet and legs, due to the irritation caused by the larvæ penetrating the epidermis.

Prophylaxis.—The chief measure consists in preventing contamination of the soil by infected excrement. It is therefore important when camping to make proper provision in the way of latrines. Care must also be taken to prevent the fouling of water and food stuffs, such as vegetables, which are eaten uncooked. It is very dangerous to go about bare-foot in regions where the disease occurs, and camping sites should always be thoroughly cleansed.

Treatment.—Efficient treatment can only be carried out in association with microscopic examination of the stools, and hence all that need here be said is that various worm medicines are employed, of which the most effectual are thymol and oil of chenopodium. These should be administered only under careful medical supervision. The anemia has to be treated, and in the case of natives a nutritious and easily-digested diet is indicated; for example, for native coolies the following has been recommended: bread 1 pound, milk 2 pints, sugar 2 ounces, 2 eggs, and 4 bananas daily. Ground itch should be treated by an ointment containing zinc oxide and salicylic acid.

The Bilharzia Worm.—This worm, of which there are two species, produces the disease known as Bilharziasis or Schistosomiasis, which occurs in one or other, or both forms, in various parts of the world, but is specially prevalent in Egypt.

Cause.—The worms, which produce either urinary or rectal bilharziasis, live in parts of the human vascular system, where they produce their eggs. These eggs are furnished with spines, and hence cause irritation when lodged in the tissues. In the urinary form the eggs have a terminal spine, in the intestinal form the spine is lateral. These eggs are passed either in the urine or in the excreta and reach water, where they develop into larvæ. The larvæ enter special species of water snails, in which they develop, producing eventually tiny forms known as cercariæ. These cercariæ escape into the water and can penetrate the unbroken skin or intact mucous membrane. They thus get access to the bodies of persons who are bathing in the infected water, or who may drink it. Once in the human body, the blood carries them to the place where they develop into the adult worms, which eventually unite, and then the females begin producing the spined eggs.

Symptoms.—In the urinary form the chief symptom is the passage of bloody urine, which usually shows itself about three months after infection, and is often associated with a good deal of irritation of the bladder and the pipe. The intestinal form may produce various symptoms. Sometimes a condition resembling enteric fever occurs, sometimes one like dysentery. Diarrhea is common. The condition is chronic and, if untreated, sets up all kinds of secondary effects, which need not be discussed.

Prophylaxis.—Carefully avoid any kind of personal contact with water which may by any possibility be infected from urine or faeces. Bathing, wading, washing in, or drinking any such waters, are all dangerous. Wherever possible, water which may be infected should be boiled. If this cannot be done, sodium bisulphate tablets may be used; two of the 16-grain water-purifying tablets in a quart water-bottle full of water are efficient. Filtration through a Pasteur-Chamberland or Doulton candle is efficient, as it excludes the cercarie. Bathing water can be rendered safe for immediate use by the addition of undiluted Army cresol in a dilution of 1 in 10,000. If the water is kept overnight, 1 in 90,000 is sufficient, as the storage of water tends to diminish infection.

Treatment.—Certain forms of antimony have been found to cure the condition, but can only be administered by a medical man. Indeed, either form of bilharziasis can be properly treated only under medical supervision. If this is not obtainable, some relief can be afforded by the use of urotropin and sedative drugs.

There are many other worm diseases which afflict man, but no good object would be served by mentioning them in detail. Most of them can be diagnosed with certainty only by a medical man using the microscope, and they all require scientific treatment which is beyond the scope of the ordinary traveller.

Yellow Fever.

This disease, the "Yellow Jack" of naval historians, occurs, so far as is known, only in parts of the New World and on the West Coast of Africa. One attack usually protects permanently against a second.

Cause.—Quite recently the organism has apparently been discovered. It is a corkscrew-shaped parasite which exists in the blood, and which

is allied to, though not identical with, the parasites of relapsing fever and tick fever. The infection is conveyed from one patient to another by the mosquito *Stegomyia fasciata*, which is a black and white insect, commonly known from its striped legs as the tiger mosquito. Incubation period two to five days.

Symptoms.—The onset of the disease is very sudden, the highest temperature being reached almost at once; then follows a period of remission or calm, the pulse becomes abnormally slow, and this stage is usually either succeeded by convalescence, or the symptoms become worse and the patient dies. Some of the symptoms much resemble malaria, but the rapidity of the onset, severe pain in the forehead, eyes, and loins, the early scantiness of the urine, the marked jaundice, the bright eyes, the narrow red tongue, and the absence of pain about the spleen are fairly characteristic.

There is considerable thirst and vomiting, and in bad cases the vomit becomes black, the colour being due to the presence of blood. (In ordinary malaria the vomit is yellow, or in severe cases, such as black-water fever, it may be of a bright or dark-green colour.) In yellow fever, jaundice is developed about the third day, and tends to increase, whilst in blackwater fever it comes on very early and soon begins to abate.

An important diagnostic sign in yellow fever is found in the fact that the pulse does not increase in rapidity as the temperature rises.

Prophylaxis.—Avoid being bitten by mosquitoes, employing the methods mentioned on pages 206, 207. It must be remembered that *Stegomyia fasciata*, unlike the anophelino mosquitoes, bites during the day, and therefore it is more difficult to avoid its unwelcome attentions. It usually breeds in the neighbourhood of houses, being what may be called a domestic mosquito; and it is of the greatest importance to abolish all potential breeding places or to protect them from the mosquito. Practically any vessel holding water may become a nursery for *Stegomyia*, and it is remarkable in what small quantities of water this mosquito will lay her eggs. Patients suffering from the disease must be isolated and kept under a mosquito net or in a mosquito-proof chamber, in order to prevent them from infecting mosquitoes, which they are capable of doing in the early part of the disease.

Treatment.—Open the bowels well by means of calomel, six grains, followed by a saline purge and hot-water enema. Some prefer castor

oil in large doses. Give ten grains of bicarbonate of soda three times a day. Give cooling drinks, such as fruit salt. Make the skin act. Apply hot fomentations to the back and mustard leaves to the pit of the stomach.

The question of feeding is very important. During the first two or three days of the fever the patient is better without any food at all. As he recovers his appetite returns, and great care must be exercised about gratifying it. Only the plainest foods in very small quantities should be permitted, the amounts being gradually increased, as otherwise relapses may occur. Stimulants are usually required in the later stages of the fever, but they must be carefully employed as they may tend to increase the vomiting. It is possible that the discovery of the parasite may lead to new and more efficient methods of treating the disease.

MEDICINES, MEDICAL APPLIANCES, ETC.

WEIGHTS AND MEASURES.

Solids.

| | A Grain | Symbol | Gr. |
|--------------|-----------|------------------------------------|-----|
| 20 Grains | 1 Scruple | { weights now } { rarely used } | ʒ |
| 60 Grains | 1 Drachm | | |
| 437.5 Grains | 1 Ounce | | |
| 16 Ounces | 1 Pound | " | lb |

Note.—An ounce weighs not 8 but rather under $7\frac{1}{2}$ drachms.

| | |
|--------------|-------------------------------|
| 1 Gramme | about $15\frac{1}{4}$ grains. |
| 1 Kilogramme | " 2 lbs. $3\frac{1}{4}$ ozs. |

Liquids.

| | | | |
|------------------------------|----------------------------|--------|---|
| 1 Minim | About 1 drop, or 0.06 c.c. | Symbol | m |
| 60 Minims | One fluid drachm | " | ℥ |
| 8 Fluid drachms (480 Minims) | One fluid ounce | " | |
| 20 Fluid ounces | One pint | " | |
| 1 Cubic centimetre | 17 Minims. | " | O |

| | |
|-------------------|----------------------------------|
| A teaspoonful | About one fluid drachm. |
| A dessertspoonful | About two fluid drachms. |
| A tablespoonful | About half a fluid ounce. |
| A wine-glassful | About two fluid ounces. |
| A tumblerful | About half a pint. |
| A litre | About a pint and three quarters. |

All bottles containing drugs should be doubly labelled, and the labels should be varnished, otherwise they will probably come off in a damp climate. Poisons should be kept in bottles of a special shape.

Drugs in a liquid state are inconvenient for travellers. They are bulky, and require very careful packing and handling.

As far as possible, therefore, compressed drugs should be selected. These must be of good quality.

Tablets are often taken in the solid form, but they will act more quickly and certainly if dissolved or suspended in about an ounce of water.

Some preparations, chiefly those used for preparing lotions, etc., e.g., of chinolol, are also made in compressed form.

In regard to drugs, I have kept well within the maximum dose, so that there may be no trouble on that account. For instance, in certain cases a medical man would give sixty drops of laudanum for a dose, but I advise travellers rarely to give more than sixty drops in twenty-four hours. The urgency of the case must be the guide as to the quantity of the drug to be given. The smallest dose which is effective is the best.

A supply of antiseptic gauze, wool and lint is necessary. The compressed forms are very convenient.

All antiseptic gauzes and other dressings should be very carefully protected from the air in order that their properties may be preserved. They should be wrapped in oiled paper or india-rubber tissue, and kept in a tin box.

A supply of bandages will also be needed. Each bandage should be two inches in width by six feet in length.

Dressing case.—The traveller should provide himself with a surgical dressing case. A suitable one should contain 1 pair of scissors, 1 pair of Spencer Wells' artery forceps, 1 probe, 1 scoop and grooved director, 1 knife with two blades, 1 small saw with a detachable handle, and a packet containing silk, wire, needles, and pins.

All active poisons mentioned in the following pages are marked with an asterisk (*).

Aloin Co. tablets.—One taken three times a day after meals, in chronic constipation, gradually reduced as bowels become regular.

Alum.—Dose, five to ten grains. Is occasionally used as an internal astringent in the treatment of diarrhoea.

A solution containing five grains to the ounce of water may be used as a mouth wash for bleeding or inflamed gums, as a gargle for relaxed and sore throats, or as a lotion for inflamed eyes.

Ten to twenty ounces of a solution containing five grains to the ounce is sometimes used as an enema to check the diarrhoea in chronic dysentery.

The tablet of alum weighs ten grains.

Ammonia.—Three preparations of ammonia, viz., Sal volatile, Carbonate of ammonia, and Liquor ammoniæ, are extremely valuable as stimulants, and in this respect they are to be preferred to alcohol. All three are similar in their action, and are useful on account of their stimulating effect upon the heart in cases of fainting, or collapse caused by snake-bite, bullet-wound, or other injury; they relieve spasm, and promote sweating in feverish states. They also cause free expectoration, and are therefore useful in the later stages of bronchitis.

The chief objection to these drugs is that their strength is rapidly lost, unless they are kept in well-stoppered bottles, and in the dark.

All preparations of ammonia should be administered in about one ounce of water.

Sal volatile, or aromatic spirit of ammonia.—Dose, twenty to sixty drops for a single administration, or up to thirty drops if repeated frequently. This is the most convenient and pleasant preparation of ammonia, but is bulky. As a local application, it is of service in relieving the pain caused by the bites of certain insects, *e.g.*, mosquitoes and fleas.

Carbonate of ammonia.—Dose, three to ten grains.

Liquor ammoniæ, or solution of ammonia.—Dose, five to twenty drops.

(Note.—This is not the strong solution, which is always labelled "Liq. Ammon. Fort.," and which is three times stronger than liquor ammoniæ.)

Ammonium chloride.—Dose, five to twenty grains. This drug is chiefly used in congestion of the liver, especially where acute inflammation or abscess is threatened; at times it is useful in neuralgia and chronic bronchitis. It is also used for inflamed and relaxed sore throat, in the form of a gargle, five to ten grains to the ounce of water.

Antipyrine.—Dose, five to ten grains. (Uses as Phenacetin.)

Araroba, Chrysarobin, or Goa powder.—Is not for internal use. One

part of the powder mixed with one of acetic acid and fourteen of lard makes what is known as araroba ointment.

Araroba ointment is useful in many skin diseases, such as psoriasis; it easily destroys the parasites in ringworm, dhobie itch, or kraw kraw. It is a powerful drug, and should be used only in small amounts, for if applied too freely it will cause some inflammation and pain. Care must be taken that it is not rubbed into the eyes.

* *Aromatic chalk with opium tablets*.—Ten grains three times a day in severe cases of diarrhœa.

* *Arsenic*.—Dose, one-sixtieth to one-fifteenth of a grain. Is a powerful and poisonous drug, and should be taken with caution. It is useful in chronic malaria, and in anemia and debility, especially that following an attack of fever.

It is best combined with iron in tablet form—iron and arsenic tablet—two of which may be taken twice a day, after food, for a week. This is a good general tonic.

Aspirin.—Dose 5 to 15 grains. Should be taken with a drink of water. Useful in rheumatic and febrile conditions; often relieves headache and the feeling of discomfort associated with chill. It is apt to be depressing in large doses, and some persons do not tolerate it well. Speaking generally it may be used in those conditions in which salicylate of soda is indicated.

Bismuth carbonate.—Dose, five to twenty grains. Useful in dyspepsia, pain in the stomach, vomiting and diarrhœa. The drug is heavy, and therefore gum or starch water should be used to suspend it.

It is often combined with opium and bicarbonate of soda to check vomiting and diarrhœa.

Bismuth may also be used as a dusting powder.

Boric acid, or boracic acid.—Chiefly used in solution, for its mild antiseptic properties, as a gargle, injection, eye lotion, or mouth wash. On the same account, it is used for washing wounds, or syringing out ulcers, or sore and inflamed ears. It is practically non-poisonous.

Lotions should contain from five to ten grains to the ounce. Boric ointment is a useful dressing for sores, burns, or wounds; it may be made by adding one part of powdered boric acid to nine of vaseline or fat.

Equal parts of finely-powdered boric acid, zinc oxide and starch

makes a good dusting powder for moist eczema, bedsores, chafes, and perspiring feet.

Boric lint (lint impregnated with boric acid) is useful as a dressing for wounds, ulcers, and abrasions.

Boric wool is absorbent cotton-wool impregnated with boric acid, and is the most generally useful antiseptic wool.

Bromides.—The bromides generally used are those of potassium, or ammonium. Dose in either case, five to twenty-five grains. They are sedatives, and are used in convulsions, epilepsy, and delirium; they relieve headache, especially if taken with sal volatile, and may be combined with chloral (see Chloral). The bromide of ammonium is less depressing than the bromide of potassium.

Calcium sulphide, i.e., sulphurated lime.—Dose, a quarter to one grain three times a day. Useful for those who are suffering from boils or carbuncles.

• *Calomel, or subchloride of mercury*.—Dose, two to five grains. Calomel may be used in almost all cases requiring an aperient; its action will be assisted by giving fruit salt, or citrate of magnesia, four hours later. In cases of insensibility or delirium it is specially useful, for the powder may be placed on the back of the tongue, and it will be swallowed unconsciously.

Four grains of calomel may usually be given with advantage, at the beginning of a malarial attack.

In syphilis, one grain may be given two or three times a day; but its action should be watched, and if it causes salivation, tenderness of the gums, and a coppery taste in the mouth, it should be discontinued until these symptoms disappear.

Camphor.—Dose, two to five grains. Is a stimulant, and an antispasmodic; it helps to calm the nervous system. It is used in cholera, and in fevers, and is taken for colds in the head.

Camphor is slightly soluble in water, and this solution makes a cooling lotion, which is useful for inflamed or painful parts. A lump of camphor is a good repellent for sand-flies.

Spirit of camphor consists of one part of camphor in ten of alcohol; the dose is ten to twenty drops.

Camphorated oil consists of one ounce of camphor in four ounces of olive oil, and makes a stimulating liniment for stiff and painful parts.

A stronger liniment may be made by adding to this an ounce of spirit, and half to one ounce of solution of ammonia or oil of turpentine.

• *Carbolic acid, or phenol.*—Dose, one or two grains may be given internally, well diluted, for acute diarrhoea, dysentery, and cholera. Is mostly used as an external application. Carbolic acid acts as a caustic, and may be applied on the end of a match in the case of boils (p. 227). A drop on a piece of cotton-wool applied to a hollow tooth quickly relieves pain.

It is much used as an antiseptic lotion for wounds and foul sores, and for cleansing hands and instruments before operation.

One part in twenty of water makes a strong solution for cleansing instruments and disinfecting dysenteric and other stools.

One part in sixty may be used for sponging or syringing sores and wounds.

One part added to nineteen of olive, or other oil, makes carbolic oil, which is a handy dressing for all kinds of wounds.

One part to nineteen parts of vaseline, or fresh lard, makes carbolic ointment.

Cascara sagrada, extract of.—Dose, two to six grains. Is a valuable aperient, especially in chronic constipation. Cascara tablets, two grains each, are convenient, and one or two should be taken at night.

Cathartic Co. Tablets.—A useful purge in cases of fever or liver derangement. Two or three for a dose when required.

Castor oil.—Dose, one to three tablespoonfuls. It is a good aperient, but is not very convenient for the traveller, as it takes up much space, which could be better used for aperients which are not so bulky, *e.g.*, calomel or cascara. The usual dose of castor oil should be somewhat reduced in the tropics, where it is often not so well borne as in temperate climates.

Note.—The seeds of the castor oil plant should not be eaten, as they are poisonous.

Chinosol is a drug which has many of the advantages of carbolic acid without its poisonous or caustic properties. It is so generally useful that, at any rate for explorers, it will largely replace carbolic acid. It is antiseptic and disinfectant in its action, can be used as a mouth wash or gargle for sore gums and ulcerated throats; it makes a good lotion for

washing the hands, instruments, or wounds, and may be syringed into fresh wounds or into chronic ulcers.

It is put up in the compressed form, each tablet weighing eight and three-quarter grains, and the strength of the solutions here given are calculated strictly from this weight.

One tablet dissolved in a pint of water makes a solution of 1 in 1000 (equal to about 1 in 40, carbolic lotion); which is the most useful for general purposes, such as an antiseptic wash for the hands or for disinfecting surgical instruments.

A tablet in two pints of water makes a solution of 1 in 2000. This may be used for washing fresh wounds, burns, and suppurating surfaces, or as a gargle for sore throat.

As a healing dusting powder, one part of chinosol may be mixed with ten of boric acid, and used in the same manner as iodoform powder.

To disinfect typhoid or dysenteric stools, dissolve four tablets in one pint of water and add the mixture to the vessel containing the motions.

* *Chloral*.—Dose, five to twenty grains. Relieves restlessness and delirium, and produces sleep. Larger doses than twenty grains should not be given. In severe convulsions, due to certain poisons, *e.g.*, strychnine, twenty grains or more of bromide of potassium may be added to the full dose of chloral, and given either by the mouth or bowel.

* *Chloroform*.—Dose, one to five drops. Two to four drops can be given with advantage with almost any drug, as a flavouring agent, and on account of its antispasmodic action.

From two to four drops put on a piece of loaf sugar and sucked will often stop sea-sickness or other vomiting.

Spirits of Chloroform, or Chloric Ether, consisting of one part of chloroform in twenty parts of alcohol, is a convenient form in which to administer the drug. It is useful in sea-sickness, cramps and colic, and should be given in doses of twenty drops added to a teaspoonful of water every quarter of an hour, until six such doses have been given.

* *Cocaine*.—A one per cent. solution may be used to diminish pain in the eye caused by injury or a piece of grit lodging under the lids. Two drops should be applied to the eyeball, and in about two minutes the application may be repeated; in another minute the sensibility of the part will be diminished, and a careful examination may be made for dust or other foreign bodies, which should of course be cautiously removed.

Creosote.—Dose, one to two drops; is best given in a capsule. In many cases of indigestion it gives great relief if administered immediately after food. Creosote applied to a hollow tooth, upon a piece of cotton-wool, will usually relieve the pain.

Creol.—This is a valuable disinfectant which is found on the market under several names.

* *Croton Oil*.—Dose, half to one or two drops, mixed with bread crumb or in a pill.

Is a powerful purgative not usually given to Europeans. Native carriers like it. Useful in the case of unconscious patients, given in butter.

Copaiba, Balsam of.—Dose, five to twenty drops three times a day. Is best taken in capsules. It increases the expectoration, and is therefore useful in bronchitis; is a stimulating disinfectant to the urine, bladder and pipe, and is used in gonorrhœa and inflammation of the bladder. It may produce an irritating rash on the skin if taken in too large quantities.

Emetics.—The following are the usual emetics:—

Common salt, two tablespoonfuls in half a pint of water.

Mustard, one tablespoonful

” ”

Ipecacuanha, thirty grains

” ”

Zinc sulphate, thirty grains

” ”

In the absence of any of the above, give copious draughts of tepid water, followed by tickling the back of the throat with the finger or a feather.

Emetine.—The active principle of ipecacuanha. Of great value in amoebic dysentery (p. 187).

Enema.—*Nutrient enema* :

Two eggs,

Half teaspoonful of salt,

A wine-glassful of milk.

Beat up the eggs, then add the salt and milk, and mix well. Raise the hips and inject slowly through the long tube well up into the bowel.

Nutrient enema :

Benger's beef jelly, two tablespoonfuls,

Milk, about three ounces.

Warm-water enema. To relieve uneasiness of lower bowel, as in dysentery, piles, etc., half a pint or more of warm water, by the short tube.

Soothing enema. Laudanum, thirty drops; warm water about two ounces. A little thin starch water or gum may be added. Inject through the short tube, and repeat the injection in three hours if patient is not easier.

Quinine enema. Quinine, twenty grains or more; warm water, about two ounces. If the patient does not retain the injection, give a second one within an hour. Select a soluble preparation of quinine, such as the bisulphate or the hydrobromide.

Aperient enema. Lather soap in thirty ounces of warm water, using plenty of soap to make a good solution; or use plain warm water or weak gruel; the addition of one or two tablespoonfuls of oil is of advantage. Inject slowly into the bowel with short tube; if it does not cause uneasiness, inject the whole amount. The injection should be retained as long as possible.

Epsom salts, or sulphate of magnesia. Dose, two teaspoonfuls or more. Is a saline purgative, giving a copious watery motion, rapid in its action, and useful in fevers or congestion of the liver. It also increases the flow of urine.

Recently has been much used in dysentery (p. 189).

Friar's Balsam.—(Tinct. Benzoin Co.) Dose, thirty drops or more.

Internally is useful as an expectorant in bronchitis. Can also be employed as an inhalation.

Externally, lint soaked with it is an efficient dressing for wounds and sores. When first applied it causes a good deal of smarting, but this soon passes off.

Gall and opium ointment is a useful application for piles.

Gauze, antiseptic. The best dressing for wounds is some form of antiseptic gauze. Cyanide gauze, which is impregnated with cyanide of mercury, is the most generally used.

Ginger, essence of.—Dose, five to twenty drops. It is useful in cases of cramp, colic, and indigestion, especially if combined with five or ten grains of bicarbonate of soda and two or three drops of chloroform.

If there is much pain, ten drops or more of chlorodyne or laudanum may be added.

* *Goa powder.*—See Araroba.

* *Goulard water.*—For external use only. Is astringent, and may be used as a lotion for inflamed joints. Is also useful as an injection in

gonorrhœa and gleet, as a soothing lotion in herpes, shingles, eczema, discharge from the ear, and itching and chafes of all kinds. *It should not be used as an eye lotion.*

Goulard water is made by adding one part of Liquor Plumbi Subacetatis Fortis, or Goulard *Extract*, and one of alcohol to seventy-eight of water.

One of the tablets of the subacetate of lead added to a quarter of a pint of water (distilled when convenient) makes a solution similar to Goulard water.

Gum acacia is used for forming a mucilage with which to suspend such drugs as carbonate of bismuth. One part of gum to three of water should be made and strained before use. Starch may be used for the same purpose.

Hazeline.—Dose, thirty to one hundred and twenty drops. It is a powerful astringent. May be applied freely to bleeding parts, such as the nose, gums, piles, or small wounds. One tablespoonful of hazeline to five of water may be injected into the bowel for bleeding piles. Hazeline snow is an elegant preparation for sunburn and other skin affections.

Ichthyol.—An ointment containing twenty per cent. of ichthyol is very soothing in most skin diseases, such as eczema and psoriasis. The ointment is of service in reducing the pain and swelling of mosquito bites.

Iodide of potassium.—Dose, five to ten grains in the later stages of syphilis.

* *Iodine, tincture of.*—Dose, two drops in a teaspoonful of water; given every hour, is most valuable for obstinate vomiting.

Used externally, it acts as a counter-irritant, and should not be painted on too freely as it may cause blistering. Does good if painted over swollen joints or enlarged glands, but should not be applied if the skin there is broken. Tincture of iodine may be painted on the chest or over the liver or spleen if there is pain. It is a valuable application for all open, recent wounds, and may be painted freely over and round the raw surface. It relieves the irritation of mosquito bites.

Is very useful in certain diseases of the skin, such as ringworm, kraw kraw, and rhobie itch.

Iodoform powder is a valuable antiseptic, and is used for all kinds of sores, or wounds, in which it rapidly promotes healing. One part of iodoform to eight parts of vaseline makes a good healing ointment.

Ipecacuanha.—Dose, expectorant, half to two grains.

„ emetic, fifteen to thirty grains.

„ for dysentery, twenty to forty grains or more.

In small doses, *e.g.*, a quarter to half a grain, is a stomachic and may check vomiting.

Was formerly much used in amoebic dysentery (p. 187). Its active principle, emetine, is now employed.

By causing free expectoration, it is very useful in bronchitis, and is then usually combined with ammonia.

Is contained in Dover's powder, and in this form is useful in coughs and colds, as it helps to cause sweating.

Iron.—Iron is much used on account of its tonic and blood-forming properties. It is especially useful in anæmia following fevers and other exhausting diseases, and it also gives tone to the nervous system.

Most preparations of iron are astringent in their action, some such as the sulphate and perchloride being more so than others; these are, therefore, useful in diarrhoea and in bleeding from the gums and bowel. Iron by its astringent action may cause constipation, and it may be necessary to add a small amount of an aperient, such as Epsom salts, to each dose.

The following preparations are those generally used:—

Tincture or perchloride of iron, or tincture of steel.—Dose, five to fifteen drops in at least an ounce of water. Good blood tonic. Is very astringent, and is therefore useful in internal bleeding and looseness of the bowels. It is of value in erysipelas.

Sulphate of iron.—Dose, one to three grains. Is a powerful astringent and blood tonic, and often does good in checking the looseness of the bowels which remains after an attack of dysentery.

Iron pill or Bland's pill.—Dose, five to fifteen grains. Is one of the best tonic preparations of iron, as it is not very astringent. It is put up in tablet form.

Solution of dialysed iron.—Dose, ten to thirty drops. Is a good blood tonic, and, unlike most preparations, is not astringent.

Parrish's food.—Dose, thirty to a hundred and twenty drops in water. Is a good preparation of iron for children.

Iron and arsenic compound tablets.—A useful tonic in convalescence from malaria, one taken three times a day after meals.

Mercurial ointment forms a useful application in certain skin diseases. As it is rather strong, it should be diluted with two parts of vaseline.

White precipitate, or ammoniated mercurial ointment.—Useful in the case of head lice and several parasitic skin diseases.

Nasopharyngeal Tablets.—Useful in nasal catarrh and pharyngitis.

* *Opium.*—Is a valuable drug, but it is also a poison, and great care should be observed in using it. Opium is narcotic and sedative in its action; it relieves pain of all kinds. Useful in diarrhoea, dysentery, cramp and colic. Promotes perspiration and checks vomiting. Sometimes it will cut short a cold or mitigate an attack of malaria.

No preparation containing opium should be given to children without medical advice, and the same is true as regards persons suffering from kidney disease.

The chief preparations containing opium are:—

* *Chlorodyne.*—The ordinary dose is ten to fifteen drops, but if there is great pain, then even thirty or forty drops may be given, but a second dose should not be administered for three or four hours; if two full doses have been given, do not give a third within at least twelve hours of the second dose, and do not give it at all if the patient is drowsy.

It is best not to give more than forty to sixty drops in twenty-four hours, unless there are very special reasons for giving a larger quantity. Is to be preferred to laudanum, as it is more palatable and more readily stops vomiting.

* *Laudanum, or tincture of opium.*—The doses and uses are precisely similar to those of chlorodyne. Laudanum has been put up in the compressed form, and is very convenient for transport.

* *Dover's powder, or compound ipecacuanha powder.*—Dose five to fifteen grains. It contains opium and a small amount of ipecacuanha. Ten grains of Dover's powder are equal to about fifteen drops of chlorodyne or laudanum. The tablet is an extremely handy preparation. Dover's powder is especially useful in coughs and colds, the ipecacuanha it contains assisting the action of the opium. If a patient who is chilled is put to bed at once, kept warm with blankets and hot-water bottles, and is given ten or fifteen grains with a hot drink, he will perspire, and possibly the cold will be cut short.

Peppermint, spirits of.—Dose, five to twenty drops. Is a valuable drug in cases of flatulence and dyspepsia, especially if combined with bicarbonate of soda; it also masks the taste of unpleasant medicines. For children, one drop of the spirit and one grain of bicarbonate of soda may be added to one teaspoonful of water, and this dose may be frequently repeated.

Pepsin tablets, a useful digestive product, taken with food when digestion is weak, or may be used to predigest it.

* *Perchloride of mercury tablets*, for making lotions for disinfecting wounds, etc.

Phenacetin.—Dose, three to eight grains. Phenacetin is used for headaches, or for reducing the temperature in malaria and other febrile diseases, and to cause sweating. As it is very insoluble, it is best taken in the form of a powder, or in alcohol and hot water.

Potassium, bromide of. See Bromides.

* *Potassium permanganate* in solid form is a mild caustic, and is the active principle of Condy's fluid, which contains about eight grains of the drug in one ounce.

It is disinfectant, deodorant, and antiseptic.

One part of this drug is soluble in about twenty parts of water.

One grain gives a purple colour to a gallon of water. Impure water turns the purple rapidly to a brown colour, therefore the permanganate is a rough test for the presence of organic matter in water.

A pale purple solution is useful as a gargle or mouth wash, also as an injection in gonorrhœa; wounds may be cleansed with a similar solution.

It is especially useful in poisoned wounds, such as snake-bites, and should in these cases be injected hypodermically (p. 281).

Is an antidote to poisoning by opium.

Of late years it has been extensively used in the treatment and prevention of cholera. The two-grain tablet is a convenient form for medication.

Purgatives may be divided into the following classes:—

1. Laxatives.
2. Simple purgatives.
3. Drastic purgatives or cathartics.
4. Saline purges.

1. Laxatives slightly stimulate the movements of the bowel, but cause practically no increase of the intestinal secretion. Examples of this class are fruit, wholemeal bread, small doses of castor oil, figs, prunes, etc. These may be given regularly in slight cases of chronic constipation.

2. Simple purges are more powerful than laxatives, and in addition to stimulating the movements of the bowel increase the secretion. The result is a soft, easy motion. Examples: rhubarb, senna, cascara sagrada.

3. Drastic purgatives or cathartics. The drugs cause a profuse flow of the intestinal secretions, and, occasionally, of the bile, with greatly increased bowel movements. They cause a copious watery evacuation, accompanied by a good deal of griping. Examples: calomel, colocynth, aloes, podophyllin, croton oil, jalap and oil of turpentine; of these, podophyllin and aloes cause an increase in the flow of bile, with increased intestinal movements, so they may be said to act directly upon the liver. The result is a profuse, watery, bile-stained motion.

Calomel does not act directly upon the liver, but stimulates the upper part of the bowel, so that its contents are hurried along before the bile can be reabsorbed, and a loose, watery, bile-stained motion ensues.

The most useful purgative of this class is the pill containing colocynth, calomel, and hyoscyamus, of which five to ten grains should be given when there is a furred tongue, constipation, heaviness or weight over the liver, and dyspepsia and loss of appetite.

4. Saline purgatives. These cause a free secretion of the intestinal juices, and a copious motion, proportionate to the size of the dose, is the result. The principal saline purges are Epsom salts (i.e., sulphate of magnesia), Glauber's salts (i.e., sulphate of soda), aciditz powder, the various forms of fruit salts, and the aperient mineral waters, such as Rubinat, Hunyadi Janos, etc.

A saline purgative may be given in the morning, to assist the action of an aperient pill administered the previous night.

Saline purgatives are useful, too, in many cases of habitual constipation, and, if necessary, a small dose may be given every morning in a tumbler of warm water.

Quinine.—Quinine is chiefly used for malarial fever, and the urgency of the case must be the guide as to the amount to be administered. It is seldom necessary to give more than ten grains three times a day; at times enormous doses, such as thirty grains three times a day, have been

given with advantage, but such doses are rarely necessary, and in the absence of a medical man should never be given.

The administration of quinine sometimes causes headache, deafness, delirium, and partial or even complete blindness. In such cases the dose should be reduced or the drug withheld until these symptoms have disappeared.

It has been stated that quinine causes blackwater fever; this, I believe, is absolutely untrue. I have seen cases of blackwater fever, apparently resulting from the neglect of malarious attacks, which date the commencement of their recovery from the first administration of quinine.

Quinine is best given in solution; the nauseous taste can be somewhat disguised by adding chloroform water or essence of ginger or lime juice to the solution. Many men take the drug in a little beer or spirit for the same purpose.

Quinine pills are, as a rule, very insoluble, therefore they are not suitable for explorers. Quinine in the form of a tablet, or in a capsule, or wrapped in tissue paper, acts well, but even tablets should be cracked or crushed. Sugar-coated products are inadmissible in the tropics.

Sometimes, owing to frequent vomiting or other cause, the quinine administered by the mouth cannot be retained. It must then be given by means of an enema or by injection into the muscles.

If the traveller decides to give an intra-muscular injection of quinine, he should only give five grains at a time. The dose should be added to about a teaspoonful of water which should then be boiled and allowed to cool. The amount of water is of little importance so long as enough is used to dissolve the drug, and keep it in solution when the water is cool enough to be injected. The less fluid, however, injected the better.

Injections are best made deeply into the muscles of the buttock. This is a method best left to a medical man, as there is danger of injuring the sciatic nerve.

The preparations of quinine.—Many preparations of quinine are made; they are all popularly known as quinine, their uses are similar, and the doses are as follows:—

Dose, one to five grains, as a tonic.

„ five or more grains as a preventive of malaria.

„ five to twenty grains, in fevers.

Sulphate of quinine.—This is the preparation most commonly used;

but it is very insoluble in water, and should be given along with a little dilute acid.

Acid sulphate of quinine, sometimes called bisulphate, soluble or neutral sulphate of quinine.

The acid sulphate is much more soluble than the sulphate, and is a more suitable preparation for administration by the mouth or for injection into the bowel.

Hydrochloride of quinine.—Is a very soluble preparation, and contains a large percentage of quinine.

Quinine hydrobromide.—Is more soluble than the sulphate, and less liable to cause headache and other quinine symptoms.

Acid quinine hydrobromide.—Very soluble and non-irritating. Solubility, one in six of water.

Tannate of quinine.—Is a weak preparation, but suitable for children. Solubility, one in ten of water.

Acid quinine hydrochloride, or quinine bihydrochloride.—Is a very soluble preparation, and is suitable for hypodermic injection, but is somewhat expensive.

It is soluble in less than its own weight of water.

For administration by the mouth or bowel, the traveller is advised to take either the hydrochloride or the bisulphate of quinine.

For intra-muscular administration the acid quinine hydrochloride is generally used.

Rhubarb, either in form of compound rhubarb pill, one of the most useful of ordinary aperients, two to four for a dose.

Compound Rhubarb Powder, otherwise known as Gregory's Powder.

Sandalwood oil.—Uses and doses as for balsam of copaiba.

Soda, bicarbonate of.—Dose, five to ten grains or more. Five to ten grains dissolved in water may be given twice a day for acidity, flatulence, heartburn. Useful in dysentery to allay irritation of stomach; for this purpose five or ten grains may be given an hour before each dose of ipecacuanha.

If the urine is acid and scalding, give twenty grains three times a day. Bicarbonate of soda is given in cases of blackwater fever when the urine is not sufficient in quantity; in such cases at least twenty grains should be given every six hours.

Soda mint tablets, useful for relieving flatulence, one or two being taken after meals.

Sodium salicylate.—Dose, ten to twenty grains. Relieves pain in rheumatic fever. Lowers temperature. Its action must be carefully watched, as too large doses may cause headache, buzzing in the ears, and even delirium.

Sulphur.—An ointment containing one part of sulphur to nine of lard, grease, or vasoline, makes a useful application for itch and other skin diseases.

Tannin.—Tannin is a powerful astringent, and may be used internally or externally.

In five to ten grain doses it helps to stop diarrhoea, bleeding from stomach, bowel, piles, and bladder. If there is continued bleeding, increase the dose to twenty grains, and repeat it as often as necessary.

Voice tablets, consisting of chlorate of potash, borax and cocaine are useful in cases of sore throat.

Warburg's tincture.—One tablet is equal to thirty drops of the ordinary tincture. Stronger tablets are also available.

To produce sweating, first open the bowels, then give four to eight of the tablets with a little hot spirit and water. If necessary, repeat the dose in three hours, and in either case withhold if possible food or drink till after this period has elapsed, but if the patient is very thirsty give hot drinks of weak tea or spirit and water. Keep him covered up and put a hot-water bottle in the bed.

Urgency of the case is a guide as to how many tablets ought to be given.

Zinc oxide alone or mixed with an equal quantity of boric acid or starch makes a useful drying dusting powder.

Zinc ointment contains three parts of zinc oxide to seventeen parts of lard or vasoline. This is a most useful application for burns, eczema, chafes and sores.

Sulphate of zinc.—As a prompt emetic, give twenty to thirty grains in half a pint of warm water. If patient does not vomit give a pint or more of warm water and tickle the back of the throat. A second dose of the drug may be given.

Two grains to an ounce of water makes a valuable astringent lotion for gonorrhoea, raw surfaces, ulcers, and inflamed eyes and ears. The strength of this solution may be gradually increased to six grains to the ounce of water.

TEMPERATURE TAKING, HYPODERMIC INJECTION, BATHS, CATHETERS,
STOMACH TUBES, ENEMAS, AND POULTICES.

Pulse, Respiration and Temperature.

Normal pulse rate (adult) about 72 per minute.

Normal respiration rate (adult), 15 to 18 per minute.

Normal temperature, 98.4° F., but varying in health between 97.5° and 99°.

Temperature Taking.

The temperature of the body may be taken in the armpit, the mouth, or the lower part of the bowel.

In the Armpit.—Dry armpit well, put the bulb of the thermometer into it, and press the arm tightly against the body, so that the thermometer will be in close contact with the skin on either side for at least five minutes.

In the Mouth.—Wash the thermometer in an antiseptic solution, dry it and place the bulb well under the tongue and close the lips on the stem; at least three minutes should be allowed. This is a more reliable way of taking the temperature than in the armpit.

In the Bowel.—If the patient is very ill and light-headed, it is not advisable to place the thermometer in the mouth, and when a patient is having a cool bath to reduce his temperature a reading will be needed at least every quarter of an hour; in these cases it is best to pass the end of the thermometer, which has been previously greased, about two inches up the bowel, and to leave it there for at least two and a half minutes.

Do not trust in half-minute or minute thermometers, always allow the full time given above. Before taking a patient's temperature see that the mercury in the thermometer is shaken down at least as low as 97° F. After the temperature has been taken, note it down carefully, wash the thermometer, and shake the mercury down to 97° F. If the thermometer is washed in hot water, the expanding mercury may break it.

Hypodermic Injection.

The best place to inject is under the skin of the back or chest. The forearm is usually selected, but there are many objections to it. If the

injection is made into the leg or arm, the point of the needle should be directed towards the body.

1. Surgical cleanliness must be observed. The hands of the operator and the skin of the patient at the spot chosen for injection must be properly cleaned with an antiseptic lotion, e.g., chinocol (1 in 1000) or carbolic acid (1 in 60). The site of injection may, as an alternative, be painted with iodine which, indeed, is the preferable method.

2. The hypodermic syringe and needle must be perfectly cleaned; if possible they should be boiled, or an antiseptic lotion, or alcohol (brandy or whisky) may be syringed through them.

3. The solution to be injected should be made in a clean, i.e., boiled, spoon, by adding the drug to boiled water.

4. Draw solution into the syringe, hold the syringe with the needle end pointing upwards, so as to allow any air to rise above the fluid, and push the piston up till all air has been driven out and the solution begins to come through the needle.

5. Pinch up the skin where the injection is to be made, push the needle well through and then under it, keeping the point slightly away from the skin until the needle is almost entirely covered. The point of the needle will now lie in the loose tissue—between the skin and the muscle—into which the fluid is to be injected.

6. Holding the needle firmly, slowly press the piston until the required amount has been injected; withdraw the needle slowly, keep the finger over the minute opening in the skin, so as to close it at once, and with another finger rub for a few seconds, where the fluid has been injected, in a direction away from the opening, to assist its absorption.

After giving an injection, wash out the syringe as before, dry needle well, and pass a piece of thin wire through it to keep it open. The needles are sent out with wire in them to keep the fine channel open; of course the wire must be removed before the needle is put on to the syringe.

As strong solutions of permanganate of potash attack the plunger of the piston, when this drug has been injected, the syringe should be well washed with water directly after its use.

Hypodermic tablets.—Solutions for injection are best made from

tablets which are specially prepared for the purpose. A hypodermic tablet should be dissolved in about ten drops of hot water, but as each contains a definite amount of the drug, it does not matter in exactly how much water the dose is dissolved. In injecting certain preparations of quinine, which are not easily soluble, so much water may be required that two or three separate injections are necessary; there is no objection to this, the important thing is to have the quinine really dissolved.

Usually only medical men should administer hypodermic injections. Frequently it is not necessary to give a hypodermic injection, for the hypodermic tablet will be absorbed, and act almost as quickly if placed under the tongue.

The traveller may be called upon to use one of the following hypodermic injections :—

Permanganate of potassium. *See Snake-bite*, p. 281.

Morphia. An injection of a quarter of a grain of morphia may be necessary when there is much pain. The soothing action of opium and chlorodyne is due to this substance.

Strychnine. *See Snake-bite*, p. 282.

Baths, etc.

Cool Bath.—Lift the patient gently in a blanket into a long bath containing water at about 90° F., add water as cold as can be obtained, keep the water circulating and running out; one boy must pour water on to the head all the time.

If a long bath is not at hand, put a blanket over a waterproof sheet, and let the patient lie on it; get six or eight boys to hold up the edges, and give patient his bath in that way.

A good plan is to dig a shallow trench in the sand and to spread a waterproof in it; it is less difficult then to keep the edges of waterproof up as the patient is lying in a groove. It is not necessary to make the bath really cold if the cool water can be kept running. I have hardly ever been able, in Africa, to get the water below 80° F.

Note the bowel temperature, and as soon as it falls to 101° F., remove the patient from the bath and put him between warm blankets, and feed

with some hot soup. If there are any signs of faintness, ammonia, or equal parts of strong spirit and water, must be given. Weak spirit and water has little or no stimulating effect on the heart, therefore, in cases of fainting, shock, exhaustion, or collapse from any cause, give a little spirit, and give it strong.

Wet Pack.—Slip a waterproof under patient, wring a sheet out of cold water and pass it under him and wrap him in it, cover with three or four blankets, and tuck him in. At first he will feel cold and chilly, but soon the surface vessels will dilate, and he will begin to feel hot, and very likely will sweat; keep him in the wet pack with the clothes carefully tucked in round the neck, feet and sides for about half an hour. Then partially dry the patient, and put him into bed between warm blankets and with hot-water bottles, and give hot drinks to encourage perspiration.

Catheters.

At least six silk-webbed catheters should be taken as part of the equipment. The most suitable sizes are, 2, 3, 4, 6, 8, 10. They should be packed in a separate box, and should be kept dry with French chalk or any other dusting powder.

Before use the catheter should lie for at least a quarter of an hour in an antiseptic solution such as chinol (1 in 1000), and the solution should be frequently syringed through it. The catheter should then be lubricated with eucalyptus, vaseline, or carbolic oil, or, better, with boric acid ointment.

Let the patient lie down, and thoroughly wash the genitals, especially the opening of the pipe, with an antiseptic solution, the operator having carefully cleaned his own hands. Then pass the catheter gently down the pipe and into the bladder. The silk-web catheters are so flexible that unless force is used they can do no harm; begin with a No. 8 size, and if this cannot be passed, try a No. 4.

After use, wash the catheter as before, dry with a soft handkerchief, and dust it with powder. On no account should the catheters be greased when they are being put away. Neglect of cleanly precautions in passing catheters may lead to inflammation of the bladder and even more serious mischief.

Stomach Tube.

The stomach tube consists of a piece of india-rubber tubing about three feet long, with a funnel at one end. The method of passing it is as follows:—The patient's jaws should be kept apart by a gag such as a piece of stick wrapped in lint placed between the back teeth on either side. The left forefinger should be passed into the patient's mouth as far as possible and the tongue drawn forward; the rubber tube, oiled or smeared with vaseline or glycerine, should then be passed by the side of the finger and down the throat for about twenty inches, taking care to use no great force. The funnel is then raised and slowly filled with water; when all the water has run down, the funnel is lowered and the liquid in the stomach is drawn out by the syphon action of the tube. The process should be repeated till the water returning from the stomach is clear.

If the patient is unconscious the tube should not be passed except by a doctor.

Enemas.

Enema Syringe.—This is fitted with long and short tube. To use the long tube, slip it over the short one, which will hold it firmly. After use hang it up to drain, dry it well, but do not oil it; carry it loose rather than coiled up, so as to avoid risk of the rubber kinking at the flexed portions of the tube.

To give an enema, the patient should be placed on his left side, and brought close to the edge of the bed, with his knees slightly drawn up towards the belly. The pipe or nozzle of the syringe should be well oiled or smeared with vaseline, and then carefully introduced into the outlet of the bowel, and passed gently upwards for about three inches, great care being taken not to exert any force.

The higher up into the bowel a nutrient or medicinal injection is passed, the more rapidly will it be absorbed; therefore the long tube is to be preferred, and the hips should be raised on a pillow, to assist the patient in retaining the injection.

A nutrient or medicinal enema is usually small in quantity, about two to four ounces, in order to prevent its being rejected by the bowel, and is administered by means of a small ball syringe provided with a long nozzle.

Before giving a medicinal or nutritive enema, it is best to wash the lower bowel with warm water, and always see that the mixture to be injected is warmed to "blood heat."

Poultices.

Linseed-meal poultice.—Mix four ounces of linseed meal into about half a pint of boiling water, constantly stirring until the mixture is smooth and even. A piece of tow, teased out to the required size, or a piece of linen or thin cloth, is placed upon a table, and the poultice turned out upon it; then spread evenly in a layer about three-quarters of an inch thick, leaving a margin of tow or linen about an inch wide all round. This margin should be folded over, and the poultice applied to the affected part—with the meal next the body.

An *Ice poultice* is made by mixing pounded ice and sawdust, and enclosing the mixture in a waterproof material such as a mackintosh or gutta-percha.

TREATMENT OF WOUNDS AND INJURIES.

By the late WILLIAM HENRY CROSSE, M.D.

In treating wounds, whether large or small, the great essential is absolute cleanliness, not simple cleanliness in the ordinary acceptance of the word, but absolute surgical cleanliness.

In the first place, it is as well to lay down the axiom that all inflammation and other complications of wounds, as suppuration and blood-poisoning, are due to germs, and germs alone. All cleansing operations and antiseptic processes are instituted with the sole idea of preventing the entrance of germs into the wound, either from the hands of the operator, the dressings, instruments, or the skin of the patient.

Antiseptics are chemical substances which have the power of killing germs outright, or so checking their growth that the cells in the blood can easily cope with them. The antiseptics that are mentioned in these notes are carbolic acid, chinolol, permanganate of potash, and boric acid.

Given the antiseptic properties of the substance, it seems a simple thing, by its application, to prevent germs either entering a wound or multiplying there, but in actual practice the germ-free cleanliness of a wound is a difficult thing to procure. The germs are everywhere—on the instruments which cause the wounds, on the skin of the patient, in the sweat glands of the skin, at the roots of the hairs, and on the hands of the operator, especially under the nails. Again, a great obstacle to the free action of antiseptics is grease or oil of all kinds. A fine coating of grease enveloping a germ offers great resistance to the action of antiseptics, and the object of the process of cleansing a wound described below is, first, to remove all the grease, and then to apply the antiseptic to destroy the germs. With care, a clean-cut wound should heal kindly, without the formation of matter.

To clean and dress a Wound.

First cover the wound itself with a small piece of cotton-wool or lint, wrung out in an antiseptic solution; then thoroughly scrub the surrounding skin with warm water and soap (soft soap for preference), using a nail brush which has been previously boiled.

Shave the skin in every case, whether thickly covered with hair or not. This shaving is most important, as it removes all fine grease-coated hairs which might favour the growth of germs, and also scrapes off the surface dirt and dead scales of skin.

After shaving, again scrub with soap and water, and wash the skin with an antiseptic lotion, such as carbolic (1 in 60), or chinosol (1 in 1000).

Having cleansed the skin, now clean up the wound itself. Thoroughly wash the wound with an antiseptic lotion, either rubbed in with lint or wool, or injected with a *glass* syringe.

All instruments, ligatures and needles should be boiled for at least five minutes in water (to which a little washing-soda may be added with advantage), and should then be dropped into an antiseptic solution. When boiling is not possible, they should be soaked in carbolic lotion, 1 in 80, for ten minutes, and then transferred to 1 in 60.

The hands of the operator must be scrubbed for some minutes with soap and warm water, and then in an antiseptic solution, particular attention being paid to the nails, which should have been cut quite short. Cleanliness of the operator's hands is the first essential of successful treatment of wounds.

The edges of small, clean-cut wounds may be brought together with adhesive plaster, but larger wounds will need antiseptic silk or gut ligatures to keep the edges applied evenly.

Large ragged wounds, with much bruising; wounds containing dirt, sand, etc., or deep wounds such as those caused by bullets or spears, should not be completely closed. They should be cleansed, as above, dusted with iodoform powder, and a strip of antiseptic gauze arranged so as to reach from the surface of the skin to the deepest part of the wound. This, which serves as a drain for the discharges, should be renewed every day until healing is fairly established. If necessary, a few stitches may be inserted in the more superficial parts of the wound to bring the edges of the skin into contact.

The wound should be dressed with strips of antiseptic gauze, lightly moistened with whichever antiseptic solution is used, and over this should be placed a pad of antiseptic wool, which should be kept firmly and evenly in place by a well-applied bandage.

A wounded limb should be kept at rest, as far as possible, either by sand-bags or a splint.

(In the absence of other antiseptics, the wound, after thorough washing, may be dressed with carbolic oil or Friar's balsam, or boric or iodoform ointment applied on lint.)

Bleeding or Haemorrhage.

General oozing from small vessels may be stopped by means of a pad made of a piece of antiseptic wool or gauze, firmly bandaged over the bleeding area.

When a large vessel, whether an artery or a vein, is cut across, profuse bleeding will take place, and immediate steps must be taken to stop this whilst suitable instruments are being obtained. (In bleeding from an artery, the blood spurts out in quick jerking jets; if coming from a vein, the blood flows in a steady continuous stream.) Pressure should therefore be applied, by means of the thumb or thumbs, or a tourniquet,* in the course of the vessel, either above or below the injury—nearer to the body than the wound if the bleeding is from an artery (Fig. 3), and beyond the wound if the bleeding is from a vein.

It will be found that the bleeding can be controlled more effectually, and with greater ease, if the vessel is compressed against a neighbouring bone.

No more pressure should be exerted than is just sufficient to stop the flow of blood.

Whilst pressure is being applied, the wound should be cleansed with some antiseptic lotion, and a wedge-shaped pad of antiseptic gauze applied and firmly held in position by a bandage.

Bleeding from the hand or forearm can generally be immediately arrested by forcibly bending up the forearm at the elbow-joint.

* A tourniquet is a special instrument devised for the purpose of applying pressure to the main vessels of the limbs; in its absence, one may be improvised by rolling a handkerchief into a narrow band, and inserting a stone or a cork between its folds to serve as a pad; the pad is adjusted over the spot where it is proposed to compress the vessel, and the ends of the handkerchief knotted loosely round the limb. A stick is now slipped between the knot and the limb, and twisted round until sufficient pressure is exerted to arrest the bleeding.

If these measures effectually control the bleeding, the pressure should be kept up for an hour or two, after which time it may be cautiously relaxed. If, after the removal of the pressure, the hæmorrhage seems to have ceased (as judged by the pad which has been kept in position not trickling with blood), apply a large pad of wool *over* the original dressing, and bandage this firmly. Dress the wound very carefully on the third day.

If, on the other hand, in spite of the treatment, the bleeding continues, the pressure must be re-applied, and the cut ends of the bleeding vessel looked for in the wound itself, and either twisted or tied with a silk ligature.

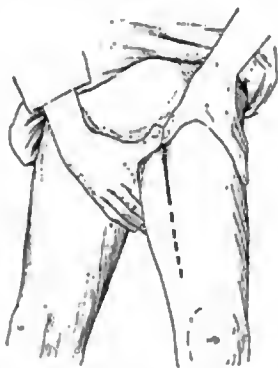


FIG. 8.—METHOD OF COMPRESSING THE MAIN ARTERY OF THE THIGH.

To twist a vessel, seize the bleeding point between the blades of the artery forceps, then, by twisting the instrument round three or four times, the vessel will become blocked or closed, and the forceps may be taken off in the course of ten minutes. The other method is to tie the vessel with a silk ligature (previously boiled), making a reef or sailor's knot, to cut short the ends of the ligature, remove the forceps, and let the vessel fall back into the wound. In any case cleanse the wound, and dress in the manner previously described.

The traveller who has taken the trouble to learn something about the treatment of wounds and severe hæmorrhage will, before his journeys

are ended, probably have opportunities of saving the life of a comrade by his skill. Nothing can be more distressing than to see a man die from a hemorrhage which anyone who has studied the subject a little would be able to control in nine cases out of ten without much difficulty. I therefore earnestly urge all travellers to gain as practical a knowledge of this subject as is possible, before leaving a civilised country.

After-Treatment of Wounds.

A clean-cut wound, which has been completely closed and properly dressed, need not be dressed again until the fourth day; and the stitches need not be removed for seven days.

On the other hand, a ragged or dirty wound, or one in which it has been necessary to insert a piece of gauze for the purpose of drainage, should be syringed out and dressed daily from the first.

The important index to the state of a wound is the patient's temperature. If, on the third day after the wound was first dressed, the temperature is normal, and subsequently remains so, the wound is probably healing well; but if the patient's temperature is up to or beyond 100° F., and the part is painful, there is probably some inflammatory change going on in the wound. The dressings should be taken off, and the wound examined. If the surrounding skin is red and shiny, and the limb swollen and tender, some of the stitches should be taken out, and the wound well syringed with an antiseptic lotion. This, with a good purge, such as calomel or Epsom salts, will probably remove all signs of inflammation; but still the wound must be dressed daily. If, however, the temperature still remains high, 100° to 101° F., or more, and the patient is restless and light-headed, all the stitches should be taken out, the wound opened up, and hot fomentations, prepared with an antiseptic lotion, applied every four hours till the temperature comes down. Tonics of quinine and iron should be given.

Erysipelas.

Erysipelas is a diffusely-spreading inflammation of the skin, caused by the presence and activity of germs, which enter through a wounded surface. It is most frequently due to want of cleanliness in the treatment of wounds. Bright's disease and gout predispose to this complaint.

Symptoms.—The disease begins with a vivid red blush, usually starting from a wound, and which has a great tendency to spread or to move from one part of the limb to another. The edge of the blush is sharply defined, and slightly raised above the surrounding skin; there is stiffness and heat in the part, with fever 103° – 104° F., not varying much; rapid pulse, headache, loss of appetite, furred tongue and constipation.

Treatment.—Isolate the patient and administer a good purgative. Give twenty drops of tincture of steel, with five grains of quinine in two ounces of water. Light diet. Stimulants will be necessary. Local treatment: flour, starch, or zinc oxide may be used to dust over the part, or zinc ointment applied on lint. The healthy skin just beyond the advancing edge may be painted with tincture of iodine.

Cellulitis.—Occasionally the infection of the skin by the germs spreads to the tissue beneath, and is then called cellulitis, or phlegmonous erysipelas. In this condition there is more swelling than in simple erysipelas, and the skin is very boggy or doughy, and retains the imprint of a finger pressed upon it. The red blush is not so vivid, being darker and more purple, and there is no well-defined edge. If left untreated, the skin will break down and die, causing extensive destruction of the part.

Treatment.—General treatment the same as for erysipelas. Locally, several incisions, each at least one inch in length, should be made into the swollen tissue where it is most boggy, and right through the skin, care being taken to avoid the larger blood-vessels; then hot fomentations of boric acid (five grains to the ounce) or other antiseptic should be applied, every two or three hours, till the swelling has subsided. The important point in the treatment of swollen and inflamed parts following wounds, when accompanied by continued or rising high temperature, is to relieve tension by making free incisions. Some knowledge of the anatomy of the parts is essential before using the knife. In any case, incisions in the arm or leg should be made parallel to and not across the limb.

Blood-Poisoning.

If a poisoned wound is left without thorough local treatment, the poisons and germs contained in the tissues are taken up by the blood, and cause *blood-poisoning*. The symptoms of this condition are high temperature,

delirium, headache, loss of appetite, vomiting, and occasionally bronchitis and pneumonia. Severe forms of blood-poisoning may lead to the formation of abscesses all over the body, with fatal result.

Treatment.—The general treatment is the same as that described for erysipelas. The local treatment is to thoroughly open up and disinfect the poisoned part.

Bruises.

A bruise should be treated by bathing with cold water, or the frequent application of wet cloths. The addition of Goulard water, gin, methylated spirits, eau de cologne, or vinegar, to the water, is beneficial.

Sprains.

The affected joint should be raised on pillows, and treated in the manner advised for bruises, but if seen immediately after the injury, firm strapping with adhesive plaster and bandaging of the part is often equally serviceable. If inflammation develops, warm fomentations will be found soothing, leeching may be necessary, and free purgation always has a good effect.

The troublesome stiffness which often remains is relieved by friction and kneading with the hand. To regain the use of the joint, it should be gently moved each day; this movement is less painful if it is performed with the joint in hot water.

Poisoned Wounds from Snakes, Animals, and Arrows, etc.

In cases of poisonous snake-bite, the marks of two fangs will usually be found.

Treatment.—Tie a piece of tape, bandage, or cord a couple of inches above the wound, i.e., between the wound and the body; tie another piece still nearer the body, say three inches from the first. Cut across the wound or wounds to encourage free bleeding.

(If a medical man is present, he may think fit to inject anti-venomous serum as an antidote to snake poison.)

Dissolve as much permanganate of potash as possible in about a teaspoonful of water, stirring well to hasten its solution. Inject about five drops of this underneath the skin, on either side of the cut, by

means of a hypodermic syringe. Some of the solution may be injected into the wound itself, or even a crystal of the drug may be pressed into the cut, or part of a crushed tablet of the drug.

It is best to keep a small bottle of the strong solution of permanganate always ready.

Give spirits strong, that is, one tablespoonful to one of water; at least four such doses in the first hour. Ammonia may also be given.

If the patient is heavy and stupid, give two tablets of strychnine (one-hundredth of a grain in each) in half a wineglassful of water, by the mouth; or dissolve two in twenty drops of water, and inject well beneath the skin into the muscles of the back. If there is no improvement within an hour, give two more tablets; and if necessary, one or two more in another hour.

After tying up a limb for a poisonous bite, there will be great pain if the ligatures have been applied tightly; the parts will swell, become very dusky, and if the ligatures are left on too long, the blood supply will be cut off, and the parts will die. Therefore, when the ligatures begin to cause much pain, loosen the one next the injured part for ten seconds, then tie again at or near the same place, and loosen the other one for a similar period, and then re-tie; repeat this about every fifteen minutes. In the course of two hours, both tapes may be taken off. The object of tying up is to prevent much of the poison getting into the system at once.

The first thing is to tie up tightly; next cut freely, and suck or squeeze out as much blood as possible, then treat with drugs,

(It is usually safe to suck a poisoned wound unless there are any abrasions or cracks in the mouth, tongue, gums, or lips, taking care to spit out the poison at once; but the mouth should be washed out immediately afterwards with a light purple solution of permanganate of potash.)

If the wounds are on the face, neck, or other spot which cannot be tied up, then it is best to cut out the part at once and wipe the wound well with the strong solution of permanganate.

In the treatment of snake-bite, pure carbolic acid, ordinary caustic, a red-hot wire, or even a burning stick may be applied to the wounds when permanganate of potash cannot be obtained. In some cases, where no other treatment is available, it is advisable to explode a pinch of gun-

powder over the place of injury, or even to blow the parts away with one's gun.

If a finger or toe is bitten by a snake which is certainly poisonous, and neither drugs nor fire are at hand, it would be best to amputate at once.

Wounds inflicted by poisoned arrows or other weapons, mad dogs, jackals, etc., should be treated in a similar manner to those caused by poisonous snakes.

Drowning.

Death from drowning usually occurs in from two to three minutes after submersion, although people have been revived after a period of five or six minutes under water.

In treating cases of apparent death from drowning, the points to be aimed at are:—

First and immediately, the restoration of the breathing.

Secondly, and *after breathing is restored*, the promotion of warmth and circulation,

1. To restore the breathing.

Roll the patient on to his face for a few seconds, placing one of his arms under the forehead; wipe away all weeds, mud, etc., from the mouth. (In this position water will more easily escape from the mouth, whilst at the same time the tongue will fall forward, and leave the entrance to the windpipe clear.)

Turn the patient on his back, on a flat surface, with the head a little higher than the feet.

Place a small hard pillow (or a rolled-up coat) *under the shoulder-blades*.

Draw the patient's tongue forward, and keep it projecting beyond the lips.

Remove all tight clothing from about the patient's neck and chest; also braces, belt, etc.

Kneel at the patient's head, grasp his arms just above the elbows, draw them gently and steadily upwards above his head, and keep them stretched in that position for two seconds (Fig. 4). (By this means air is drawn into the lungs.)

Reverse the movement, and press the patient's arms gently but firmly against the sides of the chest, keeping them in this position for two seconds (Fig. 5). (By this means air is pressed out of the lungs.)

Repeat these movements alternately and regularly, about fifteen times a minute, until natural breathing takes place, or as long as there is any hope of saving the patient. It may be necessary to continue the movements for as long as an hour.



FIG. 4.

While these movements are being carried out the wet clothing may be removed, the body gently dried, and the patient wrapped up in dry blankets.



FIG. 5.

2. To promote warmth and circulation.

Rub the limbs and body vigorously with dry towels and flannels, always rubbing from the extremities towards the heart.

Apply hot-water bottles, hot flannels, or hot bricks to the feet, arm-pits, the pit of the stomach, and between the thighs.

Immediately the power of swallowing returns, administer hot coffee, spirits and warm water, etc.

Put the patient to bed between hot blankets as soon as possible.

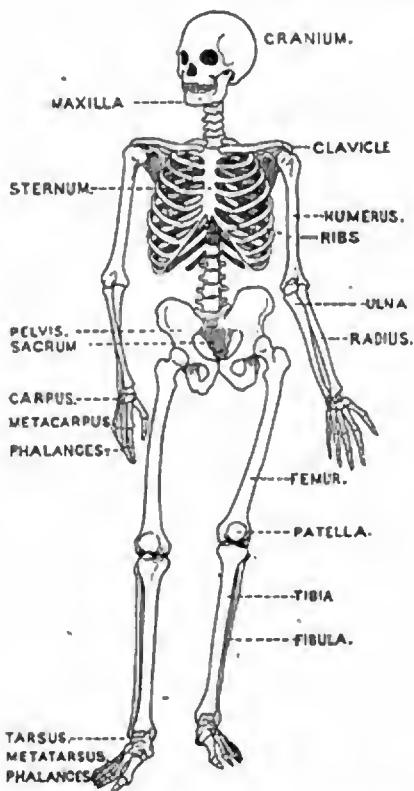


FIG. 6.—DIAGRAM OF THE HUMAN SKELETON, GIVING THE NAMES AND POSITIONS OF THE CHIEF BONES.

Fractures.

A *simple fracture* is one in which, though the bone or bones are broken, the protecting skin is not broken.

A *compound fracture* is one in which the skin, etc., is broken or cut across, so that the fracture is more or less exposed to the air. The end of either fragment of the broken bone may protrude through the skin.

A *comminuted fracture* is one in which the bone is broken into several pieces; such a fracture may be either simple or compound.

In a simple fracture great gentleness should be used in handling the parts, so as not to convert it into a compound fracture; therefore, do not undress the part; rather cut away the clothing.

A fracture which is compound is usually serious, for dirt and germs are liable to be carried into the wound and cause great mischief; in gunshot wounds, dirt or pieces of clothing may be carried into the wound.

The signs of a fracture are, firstly, the patient's own feelings, e.g., the pain which is caused on handling the part, sudden loss of power, and the sensation of grating. Secondly, on examination, most if not all of the following signs will be observed: inability of patient to move the part below the injury, swelling, unnatural movement below the site of fracture, alteration in appearance of the limb.

In fractures of the upper or lower limb there is usually shortening, the spasmodic action of the muscles causing the broken ends to ride over each other, and the greater the obliquity of the line of fracture the greater will be the shortening and alteration in appearance.

A sensation of grating is usually conveyed to the operator when he attempts to move the parts; sometimes this grating can be heard, as well as felt. Comparison of the injured with the sound limb is of the greatest importance in detecting fractures.

Treatment of Simple Fractures.

Directly a fracture of a limb is made out, a splint or splints of some kind should be applied to keep the parts fairly in position, and to prevent a broken end from being pushed through the skin. Cloths and bandages may be applied firmly round the injured part, and then extemporised

splints, such as boards, straight sticks, umbrellas, or bayonets, should be applied and kept in position till the patient is in bed.

Splints suitable to the injury should be now made and well covered with wool, lint, or cloth, special care being taken to pad them well where they are likely to press upon bony prominences, such as the inner or outer ankle. The limb must next be straightened, and any deformity caused by overriding of the fragments must be remedied by steady pulling upon the parts above and below the fracture, in opposite directions, and the parts brought into good position by manipulating the bones at the seat of fracture. The prepared splints, extending well below and above the fracture, are then fitted to the limb with cotton-wool or lint, and secured by bandages.

If there is great swelling and tenderness of a limb, then it is advisable not to apply splints at once. Sand pillows should be made, or stockings nearly filled with sand and their mouths tied, and applied one on either side of the limb, to keep it absolutely still; the painful swelling may be reduced by applying ice or evaporating lotions. When the swelling is somewhat reduced, splints may be applied after proper manipulation.

Whilst the bandages should be firmly applied so as to keep the splints in position, they must not be bound too tightly, otherwise swelling and ulceration may be caused. If there is much pain and swelling after a fracture has been set, it will be necessary to loosen the bandages.

Union of the fractured bones is generally completed in about six weeks.

Collar-bones.—Fracture of the collar-bone should be treated by placing a large wedge-shaped pad (about six inches long, by three in thickness at the upper end) in the armpit, and securing it with tapes tied over the opposite shoulder. The elbow should then be brought forward, and raised and well supported by a broad triangular bandage or handkerchief, used as a sling, and with the ends tied over the opposite shoulder. A flannel or other bandage should then be wound round the chest, so as to secure the arm from accidental movements.

Ribs.—Fracture of the ribs may be treated by wrapping a flannel bandage round the chest pretty tightly, so as to limit the movements of breathing, which are very painful. The flannel should be secured by stitching, and the upper turns should be fixed by broad tapes passed over the shoulders and firmly stitched. Firm strapping of the side with adhesive plaster is still better. For this purpose about six strips of

plaster one to two inches wide and eighteen inches long should be applied evenly round the side of the chest; each piece should be overlaid by the next piece above it for about half an inch. To secure rest for the affected side of the chest, the strapping should not only cover the broken bone, but should extend to about three inches above and below it, and should reach well beyond the middleline both in front and behind.

Upper Arm.—Fracture of the upper arm may be treated by the application of several narrow splints reaching from the armpit to the elbow, well padded, and supported in position by a bandage carried from the fingers to the armpit. Care must be taken that the splints on the inner side do not chafe the folds of the armpit. The hand and wrist should then be supported in a sling, but the elbow must be allowed to hang free.

Forearm.—Fractures of the forearm must be treated by two splints, each wider than the limb. The injured limb is allowed to hang down by the side, palm forwards. One splint reaching from the elbow to the finger-tips is applied to the back of the limb; the other is placed on the front, and only reaches from the bend of the elbow to the level of the ball of the thumb. The splints are secured temporarily by a couple of slip knots. Now bend the arm to a right angle, thumb uppermost, and bandage securely from the tips of the fingers up to the elbow.

Thigh.—Fractures of the thigh are serious; they require the patient to be kept in bed till union has been effected, and they are more likely to lead to shortening and permanent lameness if not very carefully treated, and the assistance of a skilled surgeon is urgently needed. A long splint is applied to the outside of the limb, reaching from the armpit to beyond the foot, and secured above by a bandage passing round the body, whilst the foot and leg are firmly bandaged to it below.

Leg.—Fractures of the leg should be treated by applying a splint on each side, long enough to reach from the knee to a little below the sole of the foot. They should be carefully applied with bandages, keeping the great toe in a line with the inner border of the knee-cap. When the accident occurs in the open air, the injured limb should be tied to the sound one, till the patient is brought to a place of security, the toes being prevented from pointing inwards.

Lower Jaw.—Manipulate the parts into their normal position and mould a splint of gutta percha, or other material, as accurately as

possible to the lower jaw. If a tooth is loose and prevents the two jaws meeting properly it should be taken out.

Apply the splint and keep it in position by a bandage, which should be split at the chin so as to encircle the point of the jaw; the ends of the bandage are also split as far forward as the angle of the jaw; two ends are tied behind the neck and two over the top of the head, as in the diagram, and these tied ends should be united by a bandage or tapes to keep them in position (Fig. 8).

In the absence of suitable material for making a splint, this bandage alone will have to suffice.



FIG. 7.



FIG. 8.

The patient must be fed on slops through a tube passed behind the teeth, or through a passage resulting from the loss of a tooth.

Compound Fractures.—Clean up thoroughly as described in the treatment of wounds. Wash out with an antiseptic solution, dust with iodoform, apply an antiseptic pad. Set the limb in such a manner that the wound can be dressed daily without interfering with the splints.

If the bone is protruding through the wound, it must, if possible, be got back into position. If this cannot be done it may be necessary to saw off the end of the bone to enable the wound to be closed.

If the wound is large, deep, or dirty, it should be stuffed with antiseptic gauze so that free drainage may be allowed, and the gauze should be changed each day.

After-treatment of Fractures.—Gentle movements may be cautiously

begun, in the joints above and below the injury, in about three weeks. While these are being carried out, the limb must be firmly supported to avoid interfering with the healing processes going on between the ends of the bones.

Dislocations.

Dislocations nearly always require skilled aid to reduce them.

Shoulder-joint.—Patient cannot raise the arm to his head or perform any other shoulder movements freely. The shoulder is flattened, the elbow sticks out, and the limb is usually lengthened.

Treatment.—The patient should lie down. The operator removes his own boot on the same side as that of the patient's dislocation, inserts his heel into the patient's armpit and draws the arm steadily down, at the same time pressing the heel in an outward direction; the dislocated bone should slip back into its proper position. Put a pad in the armpit and bandage the arm to the side for a week; support arm in a sling for another week or two.

Elbow-joint.—Dislocation of the bones of the forearm backwards at the elbow-joint is fairly common.

Treatment.—This dislocation can usually be reduced by placing the knee in front of the patient's elbow, and making firm traction on the forearm—which is at the same time bent a little around the operator's knee. The patient can be kept sitting in a chair while this is done, and the operator can get his knee into the required position by placing his foot on the side of the chair.

Hip-joint.—Is the most common form of dislocation. The limb is shortened, bent at the knee and twisted inwards, the great toe of the injured limb resting on the instep of foot of the opposite limb. The outer side of the hip is swollen and distorted.

Treatment.—Grasp the ankle with one hand and the knee with the other. Lift up the leg and bend it at the hip, then carry it as a whole away from the other limb as far as possible, rotate the toes and foot firmly outwards, and in that position bring the limb back parallel to the sound one.

After-treatment of Dislocations.—After dislocations, gentle movement of the joints should be begun in two weeks, so as to prevent them becoming fixed.

POISONS.

It is impossible, in the small space available, to give anything like a detailed scheme of the treatment of the various poisons, but a few hints on the essential points must not be omitted.

I have therefore arranged a list of the commoner poisons, together with the special treatment appropriate to each. Following this are a few hints more especially adapted to the requirements of travellers.

Poison should be suspected (a) when severe and alarming symptoms of illness suddenly attack a person apparently in good health; (b) if the symptoms closely follow the taking of food, drink, or medicines; (c) if several people are attacked after having partaken of the same food or drink.

The points to be attended to in the treatment of cases of poisoning are:—

- a. Remove as much of the poison as possible from the stomach.

To do this, it is usual to give an emetic, such as mustard and water, or zinc sulphate, thirty grains; or to pass the soft rubber tube down the gullet, and wash out the stomach with water.

- b. Counteract the effect of the poison by an antidote.

- c. Keep up the patient's strength till the poison is removed from the system.

- d. Relieve pain.

Travellers may be poisoned in the following ways:—

1. By poisonous bites, arrow wounds, etc.
2. By eating food poisoned by natives.
3. By eating poisonous plants, etc.
4. By eating bad meat or fish.

The treatment of *snake-bites and arrow wounds* has already been dealt with.

Poisoned food and poisonous plants.—Food is occasionally poisoned by natives, either by adding *strophanthus* leaves or other poisons. The eating of such articles may be followed by severe pain, colic, vomiting, diarrhoea or other symptoms. The general line of treatment should consist in giving emetics promptly, washing out the stomach by means of the stomach tube, and administering large quantities of water, milk, or

gruel. Distressing symptoms should be treated as they arise; thus, if convulsions occur, large doses of chloral or potassium bromide should be given; if stupor or drowsiness comes on, the patient should be forced to take hot coffee, stimulants, etc., and made to walk about. If collapse supervenes, stimulants should be freely given, the patient wrapped in blankets, and hot bottles applied to the feet.

Poisoning by bad meat, fish, etc.—The symptoms of poisoning by bad meat, etc., are severe pains in the belly, cramps, and shivering fits, followed by vomiting and diarrhœa coming on soon after its consumption, occasionally within an hour or two. The vomiting and diarrhœa are usually alarming and very severe, causing great collapse, and unless urgent remedies are applied, death may occur. The bodies of patients may be covered all over with irritating blotches, red rashes or with nettle rash.

Treatment.—Give an emetic at once. Administer a sharp purge to clear out the bowels. Use stimulants freely. Apply hot-water bottles and blankets. Give opium or chlorodyne, fifteen drops every four hours until the pain is relieved. Milk and gruel or arrowroot.

CANOEING AND BOATING.—By J. COLES.

Canoeing.

Choice of a Canoe.—In making choice of a canoe the traveller must bear in mind that, in all probability, there will be rapids in the river, which will necessitate a portage being made, and that the canoe may have to be carried over rough ground for a considerable distance. For this reason, it is far better to take two canoes of moderate size than one large one, besides which, a small canoe is much more easily handled in bad water, and even should it become necessary to carry a large load, this can easily be done by lashing two small canoes together, at about one yard apart, and laying a platform across them, on which to place the stores, &c. This, however, should not be done in dangerous and rapid rivers. The following remarks do not, therefore, apply to large canoes, which, having nearly the stability of a boat, may be handled in the same manner.

Paddles.—It will generally be found that the native paddles will be best suited for the work. The double-bladed paddle, such as is used with the Rob Roy canoe, is quite useless on a rapid and dangerous river.

Sail.—The sail should be made of duck, or some such light material, fastened to a light yard at each end, and its hoist should be about twice its breadth; its size must be in proportion to the canoe, the hoist being about one-fourth of the canoe's length. The mast should be as light as possible, with a hole at the top for the halliards to pass through freely. The end should be stepped in a chock in the bottom of the canoe (when in use), and it should be lashed to one of the stays, or cross-pieces of the canoe. The sail should never be used unless the wind is steady and abaft the beam, and the halliards should be taken to the after part of the canoe in order to stay the mast, and secured in such a manner that it can be instantly let go, when the sail will at once fall, and undue pressure on the canoe relieved.

The Tow-line.—Too much attention cannot be paid to this important article. It should be light, but of the best material (such as the rope used by the Alpine Club), as its giving way at a critical moment in a rapid is sure to be attended with most serious results.

Loading the Canoe.—The packages should not exceed 50 lbs. in weight, as they may have to be carried long distances over portages, and care must be taken not to overload the canoe. Natives, who are all good swimmers, and have nothing to lose by a capsizing, are very apt to put more into a canoe than is safe, so that it is a matter in which the traveller should use his own discretion.

In ascending a rapid river, keep close to one of its banks, and endeavour to take advantage of eddies. It will often happen that, owing to the strength of the stream, no headway can be made with the paddles, in which case recourse must be had to poling or tracking. In the event of the former, the poles should be straight and tough, and as long as can be conveniently carried in the canoe. Natives generally stand up to pole, but this the traveller should not attempt to do, or he will in all probability either fall overboard, or capsize the canoe, or both. In tracking, as great a length of line as possible should be used, as a sheer of the canoe in a rapid, with a short line, will often end in a capsizing. Only two men should remain in the canoe, one in the bow with a pole, and the other in the stern with a paddle to steer; this man should also have his pole handy. The line should be made fast to one of the stays in the bow of the canoe, and *never to a towing mast*, as in a boat; as in passing round bad corners, or places where there are snags, and where it is necessary to give the canoe a wide sheer, the leverage of the mast, if the line were fastened to the top of it, would pull the canoe over. The man in the bow, however, should always have his knife handy to cut the tow-line, should necessity arise for his doing so. In tracking, when a river passes through sandy soil, the men on the line should keep at some little distance from the edge of the bank, as it is likely to give way under their weight, and precipitate them into the river. Several men lost their lives in Fraser River, in the early days of the gold discovery, by neglecting this precaution.

In crossing from one bank of a river to the other above a rapid, be careful to ascend the river for a considerable distance before attempting to do so; and then make the crew paddle as hard as they can, keeping the head of the canoe, if anything, rather down the stream, as in the case of a rapid river you would only lose ground by trying to fight against it.

In descending a river, the traveller should keep a look-out ahead for

snags and places where the river is narrowed in between hills, as in such places there is nearly sure to be a rapid which may be so bad as to render navigation impossible. In all cases before descending an unknown rapid, he should land and inspect it throughout its *entire length* before attempting to run it in the canoe. When descending a rapid, care must be taken to keep steersome way on the canoe, as this will be needed to avoid rocks, or whirlpools. These latter are very serious dangers, as they generally do not remain fixed in one spot, but move about within a certain distance of a centre. There are, however, in most cases, short intervals when they break up, and that is the time to make a dash past them. To attempt this when they are in full swing could only end in the loss of the canoe and its occupants.

Boating.

When a traveller has to proceed for some distance overland before reaching a river or lake he purposes to navigate, he must of necessity provide himself with a boat constructed in such a manner as to be easily transported, either by being built in sections, that can be put together and taken to pieces at pleasure, or by taking one of the collapsible boats, such as Berthon's. If the former, he cannot do better than to have one built of Spanish cedar, on the same plan as that which was constructed for Sir H. M. Stanley, by Mr. James Messenger, of Teddington, with such modifications as may be necessary, when the means of transport, and the nature of his journey, have been duly considered. Collapsible boats, though very useful for ferrying across lakes or rivers, cannot, where a boat of other construction is available, be recommended for a continued exploration.

If the exploration is to be commenced at the mouth of the river, a whale-boat will be found to be the best form of boat for the following reasons. Being steered by an oar, it is more easily handled in surf or a rapid; it is generally faster than boats of the same size of ordinary build; it will carry a good cargo, sail well off the wind, and is the best boat built for crossing the bars of rivers, or landing through a surf. Such a boat can generally be purchased at foreign ports, with oars and sail, and should be well overhauled before starting.

Boat-sailing cannot be taught by any book, and certainly not by a

few short notes of this description. The traveller, therefore, who intends using a boat for exploration, should gather some experience before starting, which can be done at any fishing village on the coast. This will be the more necessary if he intends to use his boat on a lake, or for sailing along the coast, from the mouth of one river to another, and the following hints may, it is hoped, be useful to those who have had but small experience in boat-sailing.

When under sail, never, under any circumstances, allow the sheet to be made fast; a turn should be taken round a cleat, and it should be held by one of the crew ready to let go at any moment. Do not let the crew stand up, or sit on the gunwale. When about to round-to, remember that you cannot carry the same canvas on a wind that you can before it. If caught in a squall, put down the helm at once, ease the sheet, and if the squall is a bad one, lower the sail while it is still shaking. When approaching a danger, such as a rock, do not stand on if you are in doubt about weathering it, but go about in time, and have an oar ready to help the boat round if she appears likely to miss stays. Never carry too much sail, as there is considerable danger in doing so, and a boat will often sail faster with a reef taken in, than she will when unduly pressed. If necessary to take in a reef when sailing on a wind, do not luff, but check the sheet, lower the sail sufficiently to shift the tack, gather the sheet aft so that the men may take in the reef without leaning over the gunwale, shift the sheet, hoist the sail, while the sheet is slack, and do not haul the sheet aft until the men are again in their places.

Rowing.—This can only be acquired by practice, and though the traveller will seldom be called on to take an oar himself, circumstances may arise when he may have to do so, and we would, therefore, advise him to learn how to handle an oar before leaving England. Under ordinary circumstances, rowing on a river is sufficiently simple, and calls for no special instructions. The case, however, is very different when a river bar has to be crossed, or a landing made on a beach where a surf is breaking, and in either case it will be well to remember the following hints. On approaching the shore, a surf when seen from seaward never looks so bad as it really is. Where possible, a landing should not be attempted until opposite a village where the natives will be ready to assist the moment the boat touches the beach. When the surf is heavy,

the boat should be backed in, pulling a few strokes to meet each heavy sea, and then backing in again until the shore is reached. The great thing to avoid is, letting the boat get broadside to the sea, as she will then capsize; a steer-oar should always be used, as a rudder is of little use in a surf, when backing in.

In crossing a bar, if there is a good, strong, fair wind, it will generally be best to cross under sail; but if the wind is light or variable, this should never be attempted. When rowing, the crew should be cautioned to keep their oars out of the water when the sea breaks round the boat, and to commence rowing again as quickly as possible afterwards. As even in the most experienced hands a boat will often be swamped on a bad bar, it will be well, before attempting to cross it, to prepare for a swim by removing all superfluous clothing, and see that everything that will float in the boat should be left free to float, while things that will sink, such as fire-arms, &c., should be securely fastened to the thwarts.

The remarks given on canoeing with regard to loading, to ascending and descending rapid rivers, are equally applicable to boating under similar circumstances, with the following exceptions. In towing, a short mast should be used to which the line is made fast; this is stepped in the same place as the mast, and should be stayed, so as to resist the strain of the tow-line. Paddles will often be found useful in reedy rivers where the oars get entangled. As a whale-boat empty will weigh about five hundredweight, more care must be taken at portages than in the case of a canoe, which can be lifted bodily over obstacles. The stems of small trees, or the oars should be laid down under the boat, and, where possible, sharp rocks must be avoided or moved out of the way. In a rapid, two men should be in the bow with poles ready to fend off from rocks, and the most experienced man of the crew should be in the stern with the steer-oar.

Although in the foregoing remarks special reference has been made to whale-boats, the hints given are equally applicable to boats of other construction, which should, however, for river work, crossing a bar, or landing through a surf, be fitted with a steer-oar in addition to the rudder. Awnings should be taken, but in rapid rivers, and when under sail, they cannot be used.

ORTHOGRAPHY OF GEOGRAPHICAL NAMES.

By MAJ.-GEN. LORD EDWARD GLEICHEN, K.C.V.O., C.B., C.M.G., D.S.O.

Chairman of the Permanent Committee on Geographical Names.

In 1878 the Council of the R.G.S., impressed with the necessity of endeavouring to reduce the confusion existing in British maps with regard to the spelling of geographical names, in consequence of the variety of systems of orthography used by travellers and others to represent the sound of native place-names in different parts of the world, formally adopted the general principle which had been long used by many, and the recognition of which had been steadily gaining ground, viz., that in writing geographical native names vowels should have their Italian significance, and consonants that which they have in the English language.

This broad principle required elucidation in its details, and a system based upon it was consequently drawn up with the intention of representing the principal syllabic sounds: this has long been known as the R.G.S. system.

The system thus drawn up was largely adopted by the War Office, the Admiralty, and other Government Departments and private societies. But it was never officially sanctioned, for India, China,* Egypt, and many of our Colonies had already their own system (or want of system) for spelling foreign words; added to this, the private firms of map-makers had their own views on the subject, and still spelt their names in a bewildering variety of ways.

The matter came to a head in 1919, when the Admiralty approached the Royal Geographical Society with a request for the authoritative spelling of names. A committee was accordingly formed, with representatives from all Government Departments, each of which bound itself to adopt the spelling recommended.

This "Permanent Committee on Geographical Names," under the

* As far as British officials were concerned.

chairmanship of a Member of Council, R.G.S., at once got to work and proceeded to draw up :

1. A revised system of Rules and Alphabet, termed the R.G.S. II system, amplifying and improving on the old R.G.S. system of 1878. (This is given in the succeeding pages.)

2. Lists of doubtful names, with their correct spelling and other details concerned. (These will be published periodically, in the form of leaflets, in the 'Geographical Journal'.)

3. Tables of Foreign Alphabets transcribed into the R.G.S. II system. (These will be published shortly in the R.G.S. Technical Series.)

It is hoped that the above procedure will gradually result in the correct and uniform spelling of foreign Place-Names throughout the Empire.

It must also be noted that the Government of the United States of America, after an exhaustive enquiry, has adopted a system in close conformity with that of the R.G.S., and has directed that the spelling of all names in their vast territories should, in cases where the orthography is at present doubtful, be settled authoritatively by a Board appointed for the purpose. The two great English-speaking nations are thus working in harmony.

RULES FOR THE SPELLING OF GEOGRAPHICAL NAMES FOR BRITISH OFFICIAL USE.

(*Termed the R.G.S. II system.*)

1. The spelling of every place-name in an independent country or self-governing dominion using the Latin alphabet* shall be that adopted by the country or dominion, except in the case in which certain important localities have also, in addition to the official name, another customary name, notably different, in which case the name customary in British use (i.e., "conventional") may be adopted (e.g., Geneva, Warsaw, etc., for Genève, Warszawa, etc.).

2. The spelling of such place-names in colonial possessions as belong to languages coming under Rule (1) will be spelt in accordance with that rule.

3. The accents and diacritical marks in official use by the above countries will be retained. Wherever it appears desirable, the pronunciation will be shown by giving the name as transliterated on the system below.

4. All other place-names throughout the world will (with the exception of "Conventional" names and some others) be spelled in general accordance with the following system, which is based upon, and differs only slightly from, the system long used by the Royal Geographical Society, from which are derived the War Office system, 1906,† and the system of the Intelligence Division, Naval Staff, 1917.‡

The broad features of this system are—

- (a) That vowels are pronounced as in Italian and consonants as in English;
- (b) That every letter is pronounced, and no redundant letters are used.

* Including 'Latin' alphabets containing extra or modified letters, such as Cœsky, Croatian, Polish, Rumanian, etc. The pronunciation of these letters is given in the 'Alphabets of Foreign Languages,' etc., mentioned below (p. 301).

† 'Rules for the Transliteration of Place-names occurring on Foreign Maps.' Compiled in the Topographical Section, General Staff, by Alexander Knox, B.A., Map Curator. 1906.

‡ 'Instructions for the Spelling of Place-names in Foreign Countries.' Naval Staff Intelligence Division. 1917.

The system aims at giving a close approximation to the *local* pronunciation; but it is recognised that in some languages, notably Russian, Greek, and Arabic, the necessity for letter-for-letter transliteration often renders this impossible.

TABLE OF SPELLING AND PRONUNCIATION R.G.S. II.

| | | |
|------|---|----------------------|
| a | Long and short, as in <i>livā</i> | Soināli, Bukhārā.* |
| ā | As in <i>fat</i> ; rare; chiefly in Teutonic languages. | |
| ai† | The sound of the two Italian vowels; frequently slurred over, almost as in Eng. <i>aiale, ice</i> | Wadai; Shanghai. |
| au | The two Italian vowels; frequently slurred, almost as <i>ou</i> in <i>out</i> | Sakau; Bauchi. |
| aw | When followed by a consonant, or when terminal, as in <i>awl, law</i> | Dawna, Saginaw. |
| b | As in English. | |
| c | Not to be used, but always replaced by <i>k</i> or <i>s</i> ; except in the compound <i>ch</i> , and in many conventionally spelt words, as | Kandahar, Serang. |
| ch | As in <i>church</i> ; never <i>tch</i> or <i>tsch</i> for this sound | Calcutta, Celébes. |
| d†† | As in English. | Chad, Naroch. |
| dh | Soft <i>th</i> as in <i>they</i> : a slight <i>d</i> sound preceding it in Semitic languages .. | Dhuvu, Riyadh. |
| e † | Long as in <i>ch</i> ; short as in <i>bet</i> . (For the <i>e</i> sound in the French <i>je</i> , see note at end on the "neutral vowel") | Gēlo; Mafeking.* |
| (ee) | Used for <i>i</i> (q.v.) only in a few conventional names | Darjeeling, Keelung. |
| ei † | The two Italian vowels, frequently slurred | Beirut, Raheita. |

* The long and short symbols given in this column are merely for explanation, not for use.

† See note at end on *Liquid sounds*.

† Pronounced differently in Greek: see 'Alphabets of Foreign Languages transcribed into English according to the R.G.S. II system' (to be published in the R.G.S. Technical Series).

| | | |
|-----------------------|---|--|
| (eu) | Not used as a single sound. | |
| f | As in English; <i>ph</i> must not be used for this sound (except in Greek; see <i>ph</i>) .. | Mustafa, Maidan-i-Naftun. |
| g | Hard, as in <i>get</i> , <i>gift</i> ; never as in <i>gem</i> , <i>gin</i> | Gedâref, Gilgit. |
| gh | Soft guttural, the Arabic <i>ghain</i> (ġ) .. | Dagh, Baghdad. |
| h | Used only when sounded; or in the compounds <i>ch</i> , <i>dh</i> , <i>gh</i> , <i>kh</i> , <i>sh</i> , <i>th</i> , <i>zh</i> .. | Vrh, Ahmadabad. |
| i | Long as in <i>marine</i> ; short as in <i>piano</i> (not as in <i>pin</i>) | Fiji; Kibonde. § |
| j | As in English; except in transliteration of Russian, Bulgarian, and Chinese, where it equals <i>zh</i> , or the French <i>j</i> * .. | Japan, Ujiji (Eng. <i>j</i>); but Jitômir, Jelezna, Jao-ping (Fr. <i>j</i>). |
| k | As in English: hard <i>c</i> should never be used (except in conventionally-spelt words)—thus, not <i>Corea</i> , <i>Cabul</i> , but .. | Korea, Kabul. |
| kh | Hard aspirated guttural, as in the Scottish <i>loch</i> (not as in <i>lock</i>) | Khan, Sebkha. |
| l † } m } n † } | As in English. | |
| ng | Has three separate sounds, as in <i>vanguard</i> , <i>finger</i> , and <i>singer</i> . If necessary to distinguish, a hyphen may be placed, as in <i>van-guard</i> , <i>sing-er</i> | In-gâssana; Bongo; Ng-ami, Tong-a. |
| o | Long as in <i>both</i> †; short as in <i>rotund</i> .. | Angôla, Kigôma; Angôra, Hônölulu. § |

* This decision has been arrived at chiefly owing to the large number of English (and French) maps of these countries in which the *sh* sound appears as *f*.

† See note at end on *Liquid sounds*.

‡ The true Italian *o* is broader than this: almost as in *broth*.

§ The long and short symbols given in this column are merely for explanation, not for use.

| | | |
|---------------|---|------------------------------|
| ü | As in German; equals the French <i>eu</i> in <i>peu</i> ; or nearly the English sound in <i>fur</i> | Gümle, Yeniköi. |
| (oo) | Used for <i>u</i> (q.v.) only in a few conventional names; chiefly Chinese | Poona, Foochow. |
| oi * | The Italian vowels: sometimes slurred as in <i>oil</i> . If necessary for pronunciation, a hyphen may be inserted as in <i>Tro-itskoi</i> . | |
| ou * | Dissyllabic, and not as French or English <i>ou</i> | Zlatoust. |
| ow | Represents, as a diphthong, nearly the <i>au</i> sound (above) only in the romanisation of Chinese. Conventional. | |
| p | As in English. | |
| ph | As in <i>loophole</i> ; not to be used for the <i>f</i> -sound, except in Greek or conventionally | Chemulpho; Paphos, Haiphong. |
| q | Represents <i>only</i> the Arabic Qaf (ق): i.e. a guttural <i>k</i> | Qena, 'Iraq. |
| qu | Should never be employed to represent the sound of <i>kw</i> : thus, not <i>Namaqua</i> , <i>Quorra</i> , but | Namakwa, Kworra. |
| r † | As in English; should be distinctly pronounced. | |
| s | As English <i>ss</i> in <i>boss</i> , not as in <i>these</i> or <i>pleasure</i> | Rosario, Masikési. |
| sh } t † } | As in English. | |
| th | Hard <i>th</i> as in <i>thick</i> , not as in <i>this</i> | Tharmida. |

* Pronounced differently in Greek: see 'Alphabets of Foreign Languages', etc.

† See note at end on *Liquid sounds*.

| | | |
|-----|---|-------------------------------|
| u * | Long as in <i>rude</i> , or as <i>oo</i> in <i>boot</i> ; short as in <i>pull</i> | Zūlū; Rūanda.† |
| u | Represents the French <i>u</i> , as in <i>tu</i> (Fr.) .. | Ūskūb. |
| v | } As in English. | |
| w | | |
| x | | |
| y | | |
| y | Always a consonant, as in <i>yard</i> ; it should not be used as a terminal vowel, <i>e</i> or <i>i</i> being substituted; <i>e.g.</i> , not Kwaly or Wady, but | Kikuyu, Maya. Kwale, Wadi. |
| z | As in <i>gase</i> , not as in <i>azure</i> . | |
| zh | As tho <i>z</i> in <i>treasure</i> , the <i>z</i> in <i>azure</i> , or the French <i>j</i> in <i>je</i> ; but for the sound in Russian, Bulgarian, and Chinese use <i>j</i> (<i>vide</i> note above under <i>j</i>) | Zhob, Azhdaha. |

NOTES.

The doubling of a vowel or a consonant is only necessary when there is a distinct repetition of the single sound, and should otherwise be avoided

Nuulua, Loolmalasin,
Jidda, Muhammad.

Accents should not generally be employed; but in order to indicate or emphasise the stress, an acute accent may be used ..

Sarāwak, Qántara,
Tong-atābu, Paraná.

A long or short mark over a vowel (*e.g.* *ā*, *ō*) should only be used (and that sparingly) when without it there would be danger of mispronunciation

Kūt, Hashīn, Angūra,

* Pronounced differently in Greek: see 'Alphabets of Foreign Languages', etc.

† The long and short symbols given in this column are merely for explanation, not for use.

Hyphens will not be used except to indicate pronunciation, and with the Persian *izafat*, -i.

.. .. Mus-hil ; Pusht-i-Kuh.

Inverted Comma and Apostrophe.—The inverted comma ' is employed only to represent the Arabic 'ain, ع, and the Hebrew 'ayin, ע. The apostrophe ' in foreign words indicates a liquid sound. (See below.)

Liquid Sounds.—The occasional "liquid" or "palatalised" sound of *d, l, n, r, t*, etc. (as in *d'you, lure, new, clarion, tunc*), is as a rule sufficiently represented by a following *y*; where, however, owing to a following consonant, or to the letter in question coming at the end of a word, the *y* is inapplicable, the liquid sound will be represented by an apostrophe, thus: *d', l', n', r', t'*, etc.

The "Neutral Vowel."—The "indeterminate" or "neutral" vowel sound (*cr*), i.e. the sound of *a* in *marinc*, *e* in *often*, *i* in *stir*, *io* in *nation*, *o* in *connect*, *ou* in *curious*, *u* in *difficult*, etc., *e* in French *je*, or the often unwritten vowel (*-Fat-ha*) in Arabic, etc., is represented as a rule by *a*: as in *Basra, Hawiya*; but sometimes by *e*, when the sound approximates more to *e* than to *a*: as *Meshed, El Gezira*.

(In any guide to pronunciation issued by the Permanent Committee on Geographical Names, the "neutral vowel" is represented generally by the italic *e*: occasionally also by italic *a* or *u*.)

This sound must not be confused with *e-mute*, where the *e* is not sounded at all: as in *Abbeville*.

ON THE GIVING OF NAMES TO NEWLY- DISCOVERED PLACES.

The Council of the Royal Geographical Society would urge upon all travellers that in giving names to any new discoveries which they may make they should be guided by the following restrictions, which, until comparatively recent years, were commonly observed:—

1. That before putting forward any personal or fanciful name the traveller should do his best to ascertain that no local name exists, and where none is forthcoming should further consider whether one might not conveniently be derived from the vicinity, *e.g.*, from an adjacent stream, or pasture, or glacier, or from some characteristic of the natural object itself.

2. That no one should commemorate himself in this manner.

3. That any new nomenclature which a traveller may desire to suggest should be put forward tentatively and subject to the approval (1) of the Administration of the region or country, if there is one; (2) of the Official Cartographer of the country, if it possesses a Survey Department, or of the State to which the region may belong; or (3) of the Council of the Royal Geographical Society.

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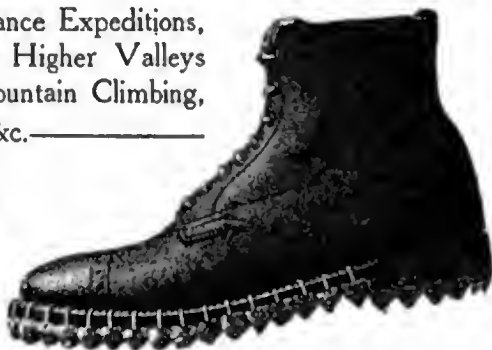
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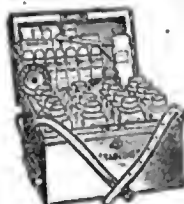


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